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ABSTRACT

This competency-based curriculum guide on the specialty area of plumbing is part of the Introduction to Construction series. The series is designed with the flexible training requirements of open shop contractors, preapprenticeship programs, multicraft high school programs, technology education programs, and cooperative education programs in mind. This guide contains four instructional units: plumbing materials, plumbing tools, plumbing layout, and plumbing basic skills. Eight basic components form a unit of instruction: performance objectives (unit and specific objectives), suggested activities for the teacher (an outline of unit contents and an instructor's guide), information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. (YLB)

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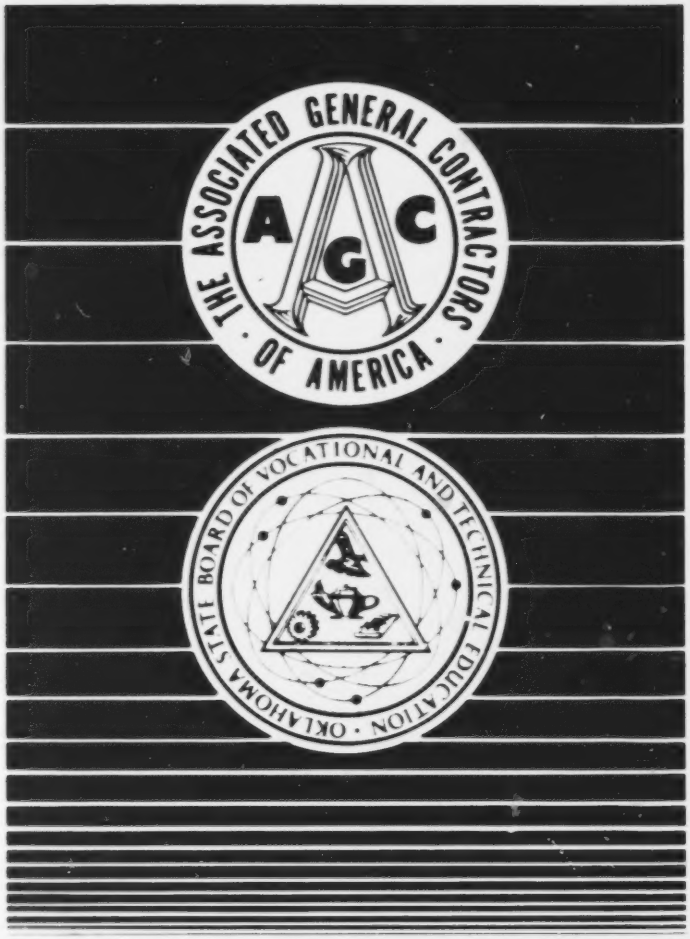

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Introduction to Plumbing

CE 051497

Introduction to Construction Series

instructor edition

88-005761

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INTRODUCTION TO PLUMBING
COMPETENCY PROFILE

Student _____ Soc. Sec. No. ___ ___ ____
Last First MI

PROGRAM _____ Grade 9 10 11 12 Adult SCHOOL _____

INSTRUCTOR _____ SCHOOL ADDRESS _____ PHONE _____

STUDENT'S HOME ADDRESS _____ DATE OF BIRTH _____ PHONE _____

STUDENT'S EMPLOYER _____ ADDRESS _____ PHONE _____

CONTACT IN CASE OF EMERGENCY: _____ PHONE _____

ADDRESS: _____

OR

ADDRESS _____ PHONE _____

The above information can be used for school records and/or to ensure safety of students. This confidential information is not to be released to employers or to the general public.

ON-JOB TRAINING/WORK EXPERIENCE

DURATION OF EMPLOYMENT	JOB TITLE	EMPLOYER	SUPERVISOR'S NAME	ADDRESS OF EMPLOYER	PHONE

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SPECIFIC JOB COMPETENCIES

Directions: Evaluate the trainee using the rating scale below and check the appropriate number to indicate the degree of competency achieved. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below. The written test score line is provided for optional teacher use. It may not be applicable in all cases. "NA" is an appropriate entry in such instances.

Rating Scale:
4 — Skilled — can perform independently with no additional training.
3 — Moderately Skilled — has performed independently during training program; limited additional training may be required.
2 — Limited Practice — has practiced during training program; additional training is required to develop skill.
1 — Exposure Only — general information provided with no practice time; close supervision needed and additional training required.
0 — No Exposure — no information nor practice provided during training program; complete training required.

4 3 2 1 0

Plumbing Materials

1. _____

WRITTEN TEST SCORE _____

4 3 2 1 0

Plumbing Tools

1. _____

WRITTEN TEST SCORE _____

4 3 2 1 0

Plumbing Layout

1. Develop three types of sketches of a drainage system in a basement floor.
2. Develop an isometric sketch of a drainage system.
3. _____

WRITTEN TEST SCORE _____

4 3 2 1 0

Plumbing Basic Skills

1. Measure and mark a predetermined length of pipe.
2. Use a pipe cutter to cut a length of steel pipe.
3. Use a hacksaw to cut a length of steel pipe.
4. Use a pipe reamer to remove burrs from steel pipe.
5. Cut threads on a piece of steel pipe.
6. Cut, ream, thread, and join a piece of one-inch galvanized steel pipe.
7. Cut, ream, and join copper tubing using the sweat method.
8. Bend copper tubing with a spring bender.
9. Cut, ream, flare, and join copper tubing using the flare method.
10. Cut, ream, and join copper tubing using the compression method.
11. Cut, ream, and join plastic pipe.
12. Join cast iron pipe to a cast iron fitting using a no-hub joint.
13. _____

WRITTEN TEST SCORE _____

Use of This Document

This document can be used to record information about the student and the skills mastered by the student. This information is useful in documenting student progress during the training program and to provide information about the student's qualifications to potential employers and for entry into advanced training programs. Instructors using AGC-CIMC instructional materials are authorized to reproduce this document as required for use in their training programs.

INTRODUCTION TO PLUMBING

Developed as a Cooperative Project by
The Associated General Contractors of America
William K. Healy, Chairman, Manpower and Training Committee
and
Oklahoma State Board of Vocational and Technical Education
John Folks, Chairman
Roy Peters, Jr., Director

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INTRODUCTION TO PLUMBING

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FOREWORD

In 1985, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project, a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This publication is the result of those original discussions and close coordination among general contractors and vocational educators. This series represents a conscious effort to coordinate the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

Although this series reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Introduction to Plumbing* should be adapted and modified to coincide with local conditions.

Roy Peters, Jr., Director
Oklahoma State Department of
Vocational and Technical Education

William K. Healy, Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

For many years The Associated General Contractors of America (AGC) has recognized the need for providing quality compentency-based instructional materials for the construction industry. AGC and the Oklahoma State Department of Vocational and Technical Education have met this challenge by providing nationally recognized curriculum and services since 1972. In 1986 AGC and Oklahoma's Curriculum and Instructional Materials Center (CIMC) determined a significant need for a series that would address training needs of open shop contractors, preapprenticeship programs, multi-craft high school programs, technology educational programs, CVET, and cooperative education programs. The Introduction to Construction Series was designed with the flexible training requirements of these groups in mind.

The Introduction to Construction Series begins with *Fundamentals of Construction* and progresses to twelve spin-off specialty publications. *Fundamentals of Construction* covers basic knowledge necessary for all individuals in construction. Each specialty area covers basic skills necessary for entry-level employment. Both vocational education and the construction industry offer more advanced courses in each specialty area and should be considered by individuals wishing to establish careers in the industry. Competency profiles (provided in the teacher edition) for the Introduction to Construction Series articulate with several more advanced AGC publications as well as publications developed by the Mid-America Vocational Curriculum Consortium (MAVCC).

Publications in this series include:

- Introduction to Bricklaying
- Introduction to Carpentry
- Introduction to Concrete Masonry
- Introduction to Ironwork
- Introduction to Electricity
- Introduction to Plumbing
- Introduction to Heating, Ventilation, and Air Conditioning
- Introduction to Sheet Metal
- Introduction to Roofing
- Introduction to Drywall
- Introduction to Insulation
- Introduction to Welding

Instructional Units

Introduction to Plumbing contains one section and four instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
  - Supplies and equipment needed
  - Amount of practice needed
  - Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

Suggested activities are included only in teacher materials. The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review or practice materials such as crossword puzzles and self-tests, or charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary. Order transparencies from the Curriculum and Instructional Materials Center, or make transparencies and place them in the notebook where they will be immediately available for use.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided

when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (white pages)

Tests are included only in teacher materials. The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Introduction to Plumbing* has been abbreviated ITP. The units are then numbered consecutively within each section. An example of a page number is ITP-1. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

For best results, provide student materials for each student. Student materials contain everything but the test, supplements, answers to assignment sheets, and suggested activities.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. A competency profile master is provided in the instructor edition of each publication. Duplicate the profile and distribute to students as required.

Other AGC Publications: AGC updates curriculum products on a continuing basis. For a free catalog describing other AGC products, call the AGC National office at 1-202-393-2040.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. You can mail the information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, it is important that you notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator for Curriculum Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

PLUMBING MATERIALS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify pipes and pipe fittings used in plumbing. The student will show this ability by completing the unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with plumbing materials to their definitions.
2. Select from a list types of materials used in plumbing pipes.
3. Select from a list types of pipes used in plumbing.
4. Match types of copper pipe with their correct identification colors.
5. Distinguish between black steel and galvanized steel pipe.
6. List advantages and disadvantages of plastic (PVC) pipe.
7. Match materials used to make plumbing fittings with their specific uses, types, and properties.
8. Identify basic plumbing branches.
9. Identify basic plumbing bends.
10. Identify basic unions and couplings.
11. Identify basic caps and plugs.
12. Identify basic bushings and nipples.
13. Identify basic closet flanges and cleanouts.
14. Identify basic no-hub fittings.
15. Identify flexible plastic (PE) insert fittings.
16. Identify PVC-DWV fittings.
17. Identify polybutylene fittings.

OBJECTIVE SHEET

18. Distinguish between the two types of threaded malleable iron fittings.

19. Select from a list types of adapters.

20. Identify basic copper tubing fittings.

PLUMBING MATERIALS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Transparency masters

1. TM #1 — Steel and Cast Iron Pipe

2. TM #2 — Types of Plastic Pipe

3. TM #3 — Vitrified Clay Pipe

D. Information sheet

E. Test

F. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Material catalogs

(NOTE: Obtain several material catalogs and display for students to review.)

2. Samples of various pipes and fittings

C. Make transparencies.

D. Introduce unit to students.

E. Provide students with objective sheet.

F. Discuss unit and specific objectives, explaining the importance of being able to identify the different types and sizes of pipes as well as the various types and sizes of pipe fittings.

G. Provide students with information sheet.

SUGGESTED ACTIVITIES

H. Discuss information sheet.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with plumbing materials.

   - Show students examples to illustrate appropriate terms.

2. Use Information Sheet, Sections II and III, to discuss types of pipe used in plumbing and the materials used in the pipe.

   - Show transparencies to help reinforce your discussion.

   - Show students samples of the various types of pipe used in plumbing and have students identify the material used in these pipe.

   - Make a game of identifying different pipe and materials in your building then have students list as many uses as possible for each different type.

3. Use Information Sheet, Section IV, to discuss the different types of copper pipe and their color codes.

   - Lay out samples of the different types of copper pipe and tags of the various colors. Have the students match up the tags with the different pipe.

   - Allow students to handle the pipe so they can see and feel the difference in the various types.

   - Discuss with the students the difference in soft and rigid copper pipe.

4. Use Information Sheet, Section V, to discuss the differences between black steel and galvanized steel pipe.

   - Discuss the differences in the two types of pipes.

   - Show samples of the two pipes, then have students list where each type of pipe may be used.

5. Use Information Sheet, Section VI, to discuss the advantages and disadvantages of plastic (PVC) pipe.

   - Discuss plastic pipe, then compare the advantages against the disadvantages for the job to be done.

6. Use Information Sheet, Section VII, to discuss the uses, types, and properties of materials used to make pipe fittings.

   - Display examples of the various fittings using the different materials.

SUGGESTED ACTIVITIES

- Discuss the uses and types of the different materials. Explain why they are used in some areas but not in others.

- Discuss the properties of the different materials. Point out that some are rigid and some are not, that some can withstand rough treatment and some cannot. Discuss how all of them must have some type of support.

7. Use Information Sheet, Sections VIII, IX and XIV, to discuss plumbing branches and bends.

   - Display examples of as many of the different branches and bends as possible.

   - Allow students to handle the branches and bends to become more familiar with them.

   - Make a game by having students identify the various branches and bends.

   - Discuss uses of the various branches and bends.

   - Discuss how the no-hub fittings can be used in walls and other areas where there is not enough room for hub-type fittings.

8. Use Information Sheet, Sections X through XII, to discuss unions, couplings, caps, plugs, bushings, and nipples.

   - Display examples of as many of those fittings as possible.

   - Discuss where, how, and why the fittings are used.

9. Use Information Sheet, Section XIII, to discuss closet flanges and cleanouts.

   - Discuss what closet flanges are and where and why they are used; also explain what cleanouts are and where and why they are used.

10. Use Information Sheet, Section XV and XVII, to discuss fittings for plastic pipe.

    - Display examples of as many fittings as possible.

    - Allow students to handle fittings.

    - Discuss the differences in the different types of plastic pipe and pipe fittings.

    - Discuss where the different types of pipe are used and why.

SUGGESTED ACTIVITIES

11. Use Information Sheet, Section XVI, to discuss PVC-DWV fittings.

    - Display as many of the different fittings as possible.
    - Allow students to handle the fittings so they may become more familiar with them.
    - Discuss where and why plastic fittings are used.
    - Compare cost of plastic fittings to metal fittings.
    - Discuss how plastic fittings and pipe are installed and how much faster they can be installed compared to steel, cast iron, and copper.

12. Use Information Sheet, Section XVIII, to discuss types of threaded iron fittings.

    - Display samples of the pressure and drainage fittings.
    - Allow students to handle and compare the two types of fittings.
    - Point out how the inside of the drainage connection is smooth and the inside of the pressure connection has an offset; explain the reasons for this.

13. Use Information Sheet, Section XIX, to discuss copper and PVC adapters.

    - Display each of the adapters and allow students to handle and compare the two.
    - Explain the differences in the two adapters.

14. Use Information Sheet, Section XX, to discuss copper tubing fittings.

    - Display examples of as many fittings as possible.
    - Allow students to handle and see the difference in the three types.
    - Discuss where and why each of the three types are used.
    - Explain how some fittings are used on different types of copper tubing for different types of jobs.
    - Explain that type "K" tubing is made in hard and soft tempers and is used for underground services and general plumbing; that type "L" is made in hard and soft tempers but is used for general plumbing and heating purposes; and that type "M" is made in hard temper only and is used in general plumbing with sweat fittings only, but not for underground services.

SUGGESTED ACTIVITIES

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest as necessary.

L. Complete appropriate sections of the competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

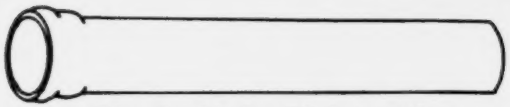
III. Unit references

A. Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing*. Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.

B. Gates Hardware and Supply Co. General Catalog. Book No. 1284-123. Tulsa, Oklahoma: n.d.

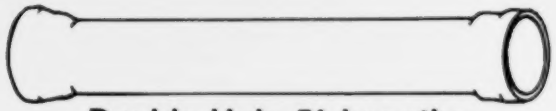
C. Stephens Industrial Supply Catalog. Oklahoma City, Oklahoma: Duncan Equipment Company, Inc. 1977.

Steel and Cast Iron Pipe



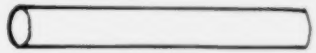
Single Hub, 5′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	20	30	40	52	65	100	145	190	255
X Wt.	25	45	60	75	95	150	215	270	375

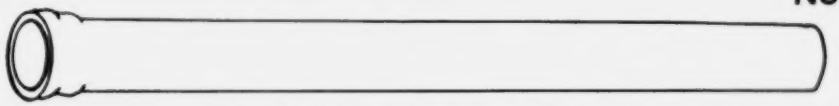


Double Hub, 5′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	21	31	42	54	68	105	150	200	270
X Wt.	26	47	63	78	100	157	225	285	395

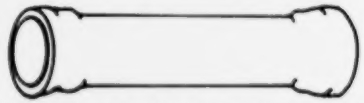


No Hub



Single Hub, 10′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	38	56	75	98	124	185	270	355	475
X Wt.	43	83	108	133	160	265	400	480	705



Double Hub, 30″ Lengths

(25″ Laying Lengths)

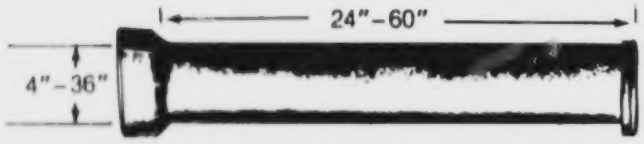
Diameter	2″	3″	4″
Std. Wt.	11	17	23
X Wt.	14	26	33

TM #1

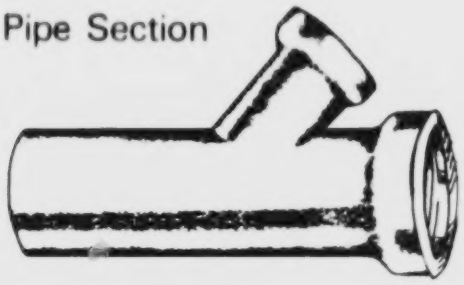
Types of Plastic Pipe

TYPE	GRADE	DIAMETER RANGE	TYPICAL APPLICATION
ABS	DWV	1 1/4" — 6"	DRAINAGE, WASTE, AND VENTING IN RESIDENTIAL CONSTRUCTION
	SERVICE	1 1/4" — 6"	NONCODE APPLICATIONS
PVC	DWV	1 1/4" — 6"	DRAINAGE, WASTE, AND VENTING IN RESIDENTIAL CONSTRUCTION
	THIN WALL	1 1/2" — 4"	DRAINAGE, WASTE, AND VENTING NOT ENCLOSED WITHIN WALLS (NOT ALLOWED BY SOME CODES)
	PRESSURE PIPE	1 1/2" — 6"	SELECTION BASED ON PRESSURE OF FLUID WHICH IS TO FLOW THROUGH PIPE
CPVC		1/2" — 3/4"	HOT WATER LINES
PE	HIGH DENSITY	1/4" — 12"	GAS PIPING
	MEDIUM DENSITY	1/4" — 48"	IRRIGATION, SEWER MAINS
SR		1/2" — 12"	STORM DRAINS, SEPTIC TANK, AND LEACH FIELDS

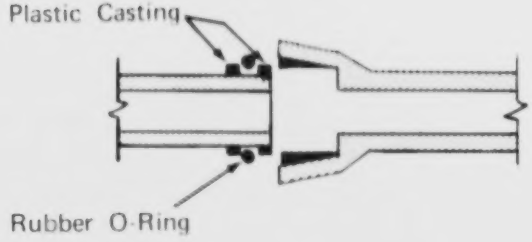
Vitrified Clay Pipe

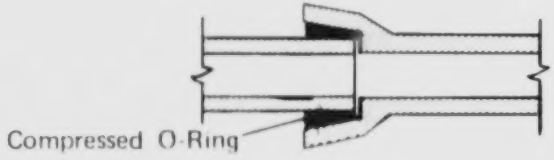


Pipe Section

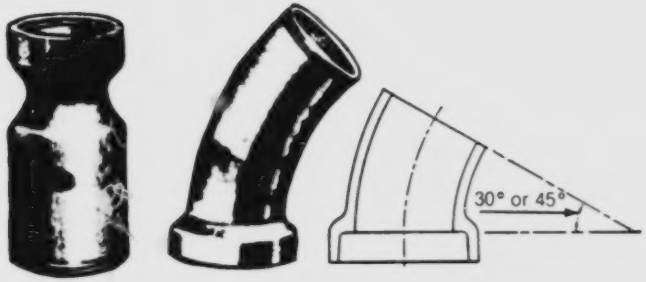


Wye Tee Elbow





Compression joint in vitrified clay pipe assembles rapidly and needs no additional "set-up" time.



Bushing Elbow (30° - 45°)

TM #3

ITP-13

PLUMBING MATERIALS
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with plumbing materials

A. **Galvanize** — To coat metal with zinc by hot dipping in order to prevent rusting

B. **PVC** — Rigid plastic pipe

(NOTE: PVC pipe is generally white. PVC is the abbreviation for polyvinyl chloride.)

C. **Nipple** — Short piece of threaded pipe 12 inches or less in length

D. **Flexible plastic pipe** — Pipe which comes in a roll and uses slip-in fittings with clamps

E. **Tube** — Fluid-carrying pipe which has a thin wall

F. **Plumbing code** — Laws and regulations which stipulate type, size, and quality of pipe material to use

G. **Adapter** — Type of fitting which joins pipes of different materials

H. **Bushing** — Fitting used to reduce pipe size

I. **Pressure fitting** — Designed to withstand specified pressure

J. **Fitting gain** — That space which the pipe requires in the fitting

K. **Malleable** — Lacking brittleness

L. **Oakum** — Loosely wooven hemp rope which has been treated with a waterproofing substance and is used to make caulked joints in cast iron pipe systems

M. **FPT** — Female pipe thread

N. **MPT** — Male pipe thead

O. **Rigid** — Inflexible

P. **Thread tape** — Substitute for pipe compound

(NOTE: Thread tape is often Teflon tape.)

II. Types of materials used in plumbing pipes

A. Water pipes

1. Copper (rigid or soft)

2. Galvanized steel

INFORMATION SHEET

3. PVC (polyinyl chloride), PE (polyethylene), PB (polybutylene)

B. Soil and waste

1. Copper
2. Cast iron
3. PVC plastic
4. Galvanized steel
5. Vitrified clay tile

III. Types of pipe used in plumbing

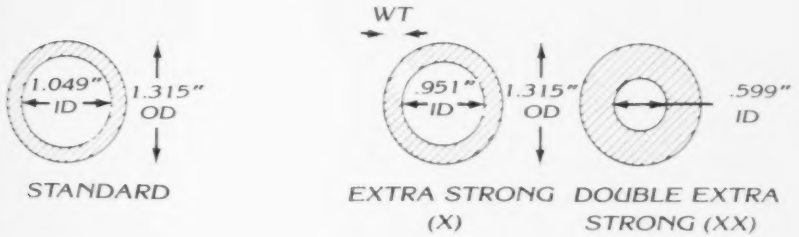
A. Steel

1. Black
2. Galvanized

(NOTE: Steel pipe comes in three different grades or strengths: standard, extra strong, and double extra strong. Standard weight is adequate for most plumbing installations. The outside diameter [OD] of the pipe remains the same regardless of the wall thickness [WT]. See Figure 1.)

EXAMPLE:

FIGURE 1



B. Cast iron

1. Hub and spigot
2. No-hub

(NOTE: Cast iron pipe is available in one grade, service [SV].)

C. Plastic

1. PVC (polyvinyl chloride)

INFORMATION SHEET

2. PE (polyethylene)

(NOTE: Plastic pipe is available in four different strengths: schedule 40, schedule 80, pressure pipe, and pipe used for noncode applications. The selection of pressure pipe is based on the pressure of fluid that is to flow through the pipe. PE pipe is available in high density, which is used for gas piping and water service, and medium density, which is used for irrigation and sewers.)

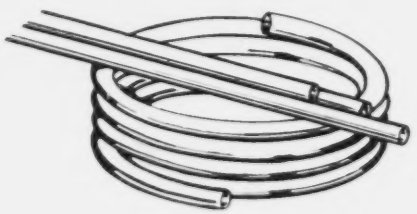
D. Copper

1. DWV — Rigid
2. M — Rigid
3. L — Rigid
4. L — Soft
5. K — Rigid
6. K — Soft

(NOTE: Rigid copper pipe is available in 20-foot lengths and soft copper pipe is available in 40-, 60-, and 100-foot coils. See Figure 2.)

EXAMPLE:

FIGURE 2



E. Vitrified clay

(NOTE: Vitrified clay pipe must be dense [concentrated] enough to withstand penetration and deterioration from acids and corrosive wastes. The vitreous [glass-like] surface is formed by mixing clay with salt and then firing [baking at high temperature]. Usually the fitting and pipe are combined into one piece.)

IV. Identification colors of types of copper pipe

A. DWV-Rigid — Yellow

B. M-Rigid — Red

INFORMATION SHEET

C. L-Rigid — Blue

D. L-Soft — Blue

E. K-Rigid — Green

F. K-Soft — Green

V. Differences between black steel and galvanized steel pipe

A. Black steel

1. Varnished black to help prevent rust and distinguish it from galvanized pipe

2. Limited to use with noncorrosive substances, such as gas, air, and steam

B. Galvanized steel pipe

1. Hot dipped in zinc to resist rusting

2. Used for applications with corrosive liquids such as water

(NOTE: Care should be taken with wrenches to avoid removing too much zinc coating.)

VI. Advantages and disadvantages of plastic pipe (PVC-DWV)

A. Advantages

1. Lightweight

2. Resists corrosion and electrolysis

3. Easily installed

4. Comparatively inexpensive

B. Disadvantages

(NOTE: Check manufacturer's specifications.)

1. Will not withstand temperatures over 150 degrees Fahrenheit

2. Not stable at pressures over 100 psi

VII. Uses, types, and properties of materials used to make pipe fittings

A. Cast iron

1. Uses

a. Drains

b. Sewers

INFORMATION SHEET

c. Vents

2. Types

a. Hub and spigot

b. Non-hub

3. Properties

a. Very brittle, cannot withstand rough treatment

b. Rigid

c. Heavy, needs strong support or base

B. Copper

1. Uses

a. Water services and distribution

b. Drainage (above ground)

c. Vents

d. Gas (LPG)

2. Types

a. Wrought

b. Cast (brass)

3. Properties

a. Fairly malleable

b. Rigid

c. Lightweight, needs light support

C. Plastic

1. Uses

a. Drains

b. Vents

c. Water services

d. Irrigation

2. Common types

a. PVC — Polyvinyl chloride

b. PE — Polyethylene

c. PB — Polybutylene

(NOTE: Check other types of plastic in your locality.)

3. Properties

a. Very malleable

b. PVC is fairly rigid

c. PE is fairly flexible

d. Lightweight, needs light support

D. Malleable cast iron

1. Uses

a. Gas pipe (black)

b. Water service and distribution (galvanized)

2. Types

a. Black iron

b. Galvanized

3. Properties

a. Fairly malleable

(NOTE: Threads can be easily damaged.)

b. Rigid

c. Heavy, needs strong support or base

d. Tends to rust

E. Brass

1. Uses

a. Gas lines

b. Water services and distribution

2. Types

a. Compression

INFORMATION SHEET

b. Flare

3. Properties

a. Fairly malleable

(NOTE: Threads can be easily damaged.)

b. Rigid

c. Lightweight, needs little support

F. Vitrified clay

1. Uses

a. House sewer

b. City sewer

2. Type — Hub (bell) and spigot; plain end with coupling

3. Properties

a. Very brittle, cannot withstand rough treatment

b. Rigid

c. Medium weight

(NOTE: Vitrified clay pipe is always installed underground, and it needs a firm, even base.)

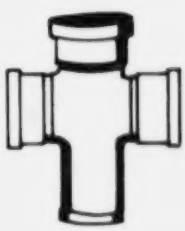
VIII. Basic plumbing branches (Figures 3-14)

A. Tee

FIGURE 3

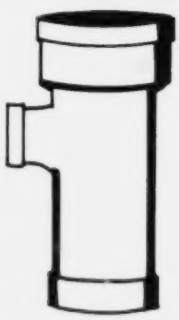
B. Double tee

FIGURE 4



C. Tapped tee

FIGURE 5



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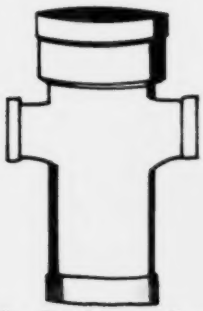
INFORMATION SHEET

D. Double tapped tee

FIGURE 6



E. Sanitary tee

FIGURE 7

F. Long turn sanitary tee (combination wye and 1/8 bend)

FIGURE 8

G. Double sanitary tee

FIGURE 9

H. Test tee

FIGURE 10

I. Wye

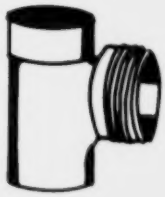
FIGURE 11

J. Double wye

FIGURE 12

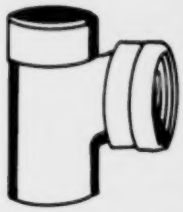
K. Male adapter

FIGURE 13



L. Female adapter

FIGURE 14



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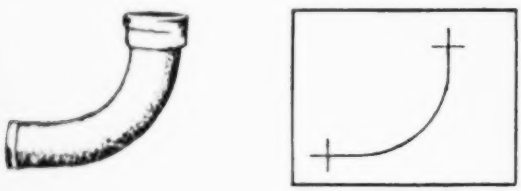
INFORMATION SHEET

IX. Basic plumbing bends (Figures 15-25)

A. Quarter (1/4) = 90°

FIGURE 15



1. Short turn

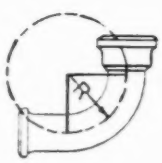
EXAMPLE:

FIGURE 16

2. Medium turn

EXAMPLE:

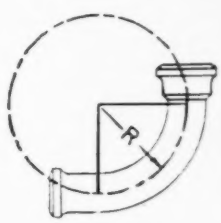
FIGURE 17



3. Long turn

EXAMPLE:

FIGURE 18



B. Fifth (1/5) = 72°

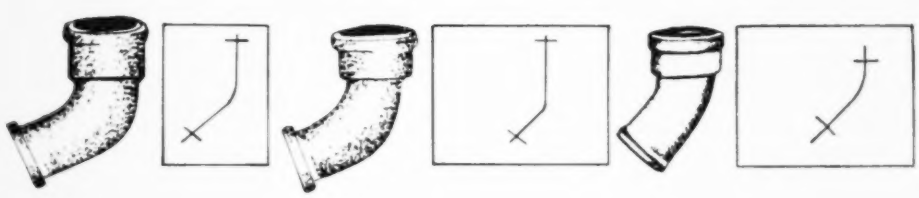
FIGURE 19

C. Sixth (1/6) = 60°

FIGURE 20

D. Eighth (1/8) = 45°

FIGURE 21



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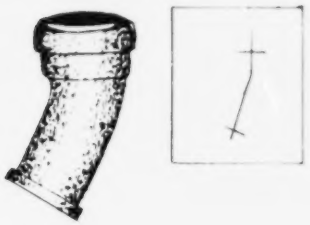
INFORMATION SHEET

E. Sixteenth ($1/16$) = 22.5°

FIGURE 22



F. Street elbow (male)

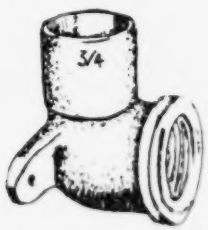
FIGURE 23

G. Adapter elbow (female)

FIGURE 24

H. Drop ear elbow (copper to FIP)

FIGURE 25

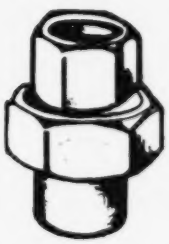


Figures 22 through 25 used with permission of NIBCO Inc., Elkhart, Indiana.

X. Basic unions and couplings (Figures 26-32)

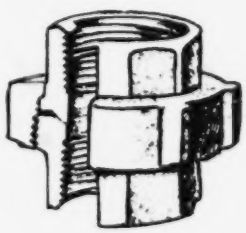
A. Straight union

FIGURE 26



B. Ground joint union

FIGURE 27

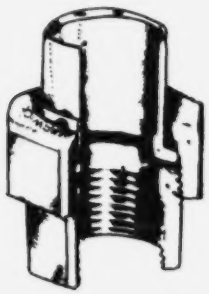


Figures 26 and 27 used with permission of NIBCO Inc., Elkhart, Indiana.

INFORMATION SHEET

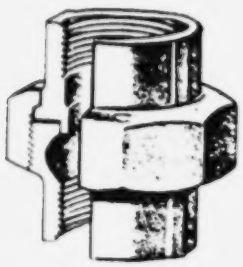
C. Gasket-type union

FIGURE 28



D. Dielectric union

FIGURE 29



E. Straight coupling

FIGURE 30

F. Reducing coupling (bell reducer)

FIGURE 31

G. Adapter coupling (male to female)

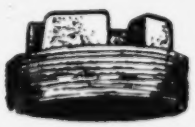
FIGURE 32

Figures 28 through 32 used with permission of NIBCO Inc., Elkhart, Indiana.

XI. Basic caps and plugs (Figures 33-35)

A. Solid plug

FIGURE 33



B. Cored plug

C. Cast iron cap

FIGURE 35

Figures 33 through 35 used with permission of NIBCO Inc., Elkhart, Indiana.

INFORMATION SHEET

XII. Basic bushings and nipples (Figures 36-49)

A. Bushings

1. Copper

FIGURE 36

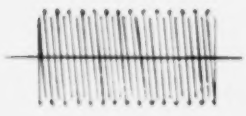
2. Malleable cast iron

FIGURE 37

B. Nipples

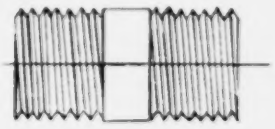
1. Close

FIGURE 38



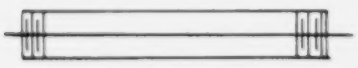
2. Shoulder

FIGURE 39



3. Long

FIGURE 40



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XIII. Basic closet flanges and cleanouts (Figures 41-44)

A. Closet flanges

1. No-hub slot and notch

FIGURE 41

2. PVC

FIGURE 42

Figures 41 and 42 used with permission of NIBCO Inc., Elkhart, Indiana.

INFORMATION SHEET

B. Cleanouts

1. Copper

FIGURE 43

2. Cast iron

FIGURE 44

Figures 43 and 44 used with permission of NIBCO Inc., Elkhart, Indiana.

XIV. Basic no-hub fittings (Figure 45-47)

A. Wye

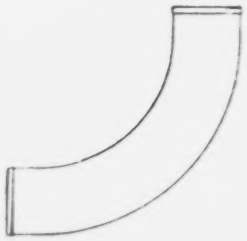
FIGURE 45

B. Sanitary tee

FIGURE 46

C. Long turn 1/4 bend

FIGURE 47



Figures 45 through 47 used with permission of NIBCO Inc., Elkhart, Indiana.

XV. Flexible plastic (PE) insert fittings (Figures 48-55)

A. Tee

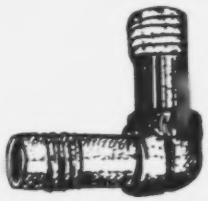
FIGURE 48

B. Tapped tee

FIGURE 49

C. 90° elbow

FIGURE 50



INFORMATION SHEET

D. 90° female adapter

FIGURE 51

E. Coupling

FIGURE 52

F. Male adapter

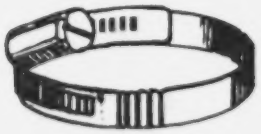
FIGURE 53

G. Male steel adapter

FIGURE 54

H. Clamp

FIGURE 55



XVI. PVC-DWV fittings (Figures 56-93)

A. Sanitary tee

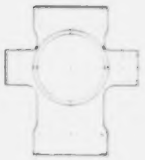
FIGURE 56

B. Sanitary tee with left side inlet

FIGURE 57

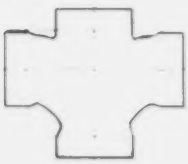
C. Sanitary tee with two side inlets

FIGURE 58



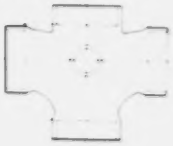
D. Double sanitary tee

FIGURE 59



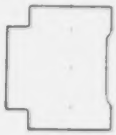
E. Double sanitary tee with side inlet

FIGURE 60



F. Horizontal twin tee (frog eye tee)

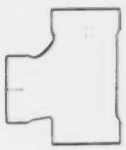
FIGURE 61



INFORMATION SHEET

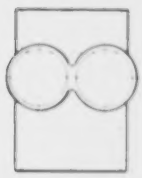
G. Fixture tee

FIGURE 62



H. Vent tee (straight tee)

FIGURE 63

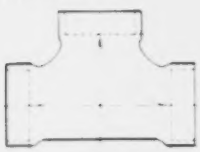


I. Cleanout tee (test tee)

FIGURE 64

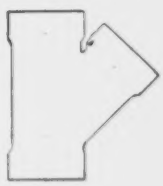
J. Two-way clean out

FIGURE 65



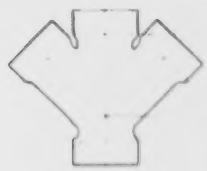
K. Wye

FIGURE 66



L. Double wye

FIGURE 67

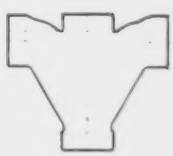


M. Combination wye and 1/8 bend

FIGURE 68

N. Double combination wye and 1/8 bend

FIGURE 69



O. Upright wye

FIGURE 70

P. 1/4 bend (90° L.T ell)

FIGURE 71

Q. 1/4 bend, street (90° L.T street ell)

FIGURE 72

R. 1/4 bend, vent

FIGURE 73

INFORMATION SHEET

S. 1/4 bend vent, street

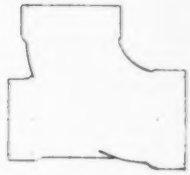
FIGURE 74

T. Double 1/4 bend

FIGURE 75

U. 1/4 bend with low heel inlet

FIGURE 76



V. 1/4 bend with low heel inlet

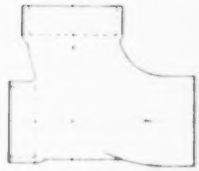
FIGURE 77

W. Long sweep 1/4 bend

FIGURE 78

X. Long sweep 1/4 bend with low heel inlet

FIGURE 79



Y. Long sweep 1/4 bend with side inlet

FIGURE 80

Z. 1/8 bend

FIGURE 81

AA. 1/8 bend, street

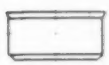
FIGURE 82

BB. Coupling

FIGURE 83

CC. Reducer bushing

FIGURE 84



DD. Hub adapter (adapts CI hub to ABS/PVC-DWV)

FIGURE 85

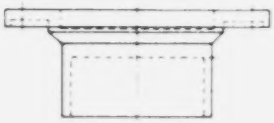
INFORMATION SHEET

EE. No-hub adapter (adapts CI no-hub to ABS-DWV)

FIGURE 86

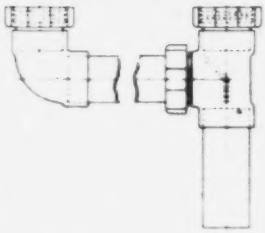
FF. Closet flange

FIGURE 87



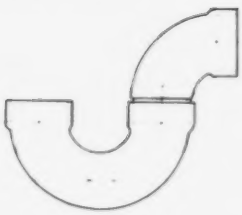
GG.Continuous waste

FIGURE 88



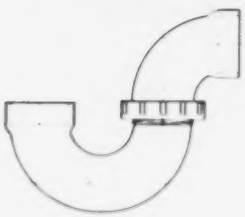
HH.P-trap

FIGURE 89



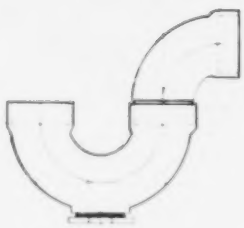
II. P-trap with union

FIGURE 90



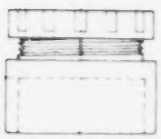
JJ. P-trap with cleanout

FIGURE 91



KK. Trap adapter

FIGURE 92



LL. Closet bend

FIGURE 93

INFORMATION SHEET

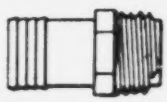
XVII. Polybutylene fittings (Figures 94-99)

A. Insert coupling

FIGURE 94

B. Insert male adapter

FIGURE 95

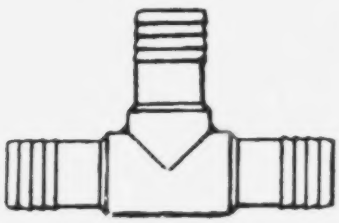


C. Insert elbow

FIGURE 96

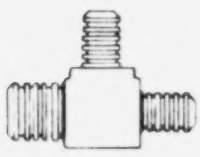
D. Insert tee

FIGURE 97



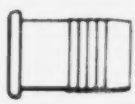
E. Reducer tee

FIGURE 98



F. Insert plug

FIGURE 99

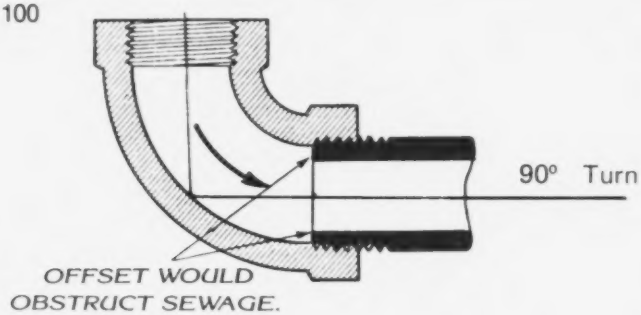


XVIII. Two types of threaded malleable iron fittings (Figures 100 and 101)

A. Pressure

1. Used for water, gas, and air vent lines
2. Designed for absolute degree turns

FIGURE 100

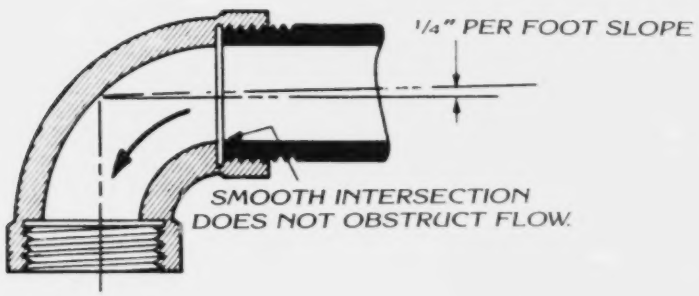


INFORMATION SHEET

B. Drainage

1. Used for drainage lines
2. Tapped with a pitch of 1/4" per foot

FIGURE 101



3. Minimum size manufactured is 1 1/4 inch
4. Insides smooth and shaped for easy flow

XIX. Types of adapters

A. Copper

1. Copper to cast iron (caulked)
2. Copper to threaded pipe

B. PVC plastic

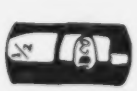
1. PVC to cast iron
2. PVC to threaded pipe

XX. Basic copper tubing fittings

A. Sweat-type fittings (Figures 102-112)

1. Coupling (copper to copper)

FIGURE 102



2. 45° elbow (copper to copper)

FIGURE 103

INFORMATION SHEET

3. 90° elbow (copper to copper)

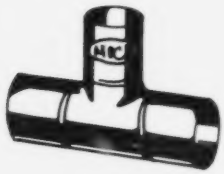
FIGURE 104

4. 45° street elbow (copper to fitting)

FIGURE 105

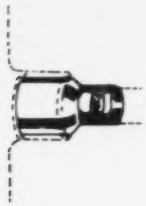
5. Tee (copper to copper to copper)

FIGURE 106



6. Reducer (fitting to copper)

FIGURE 107



7. Female adapter (copper to female SPS)

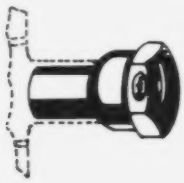
FIGURE 108

8. Male adapter (copper to male SPS)

FIGURE 109

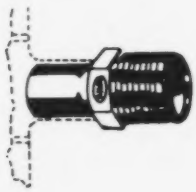
9. Female fitting adapter (fitting to female SPS)

FIGURE 110



10. Male fitting adapter (copper to male SPS)

FIGURE 111



INFORMATION SHEET

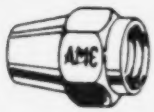
11. Flush bushing (fitting to copper)

FIGURE 112

B. Flare-type fittings (Figures 113-123)

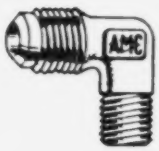
1. Flare nut

FIGURE 113



2. Elbow (flare to male pipe)

FIGURE 114



3. Elbow (flare to flare)

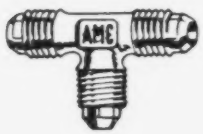
FIGURE 115

4. Street elbow (flare to female pipe)

FIGURE 116

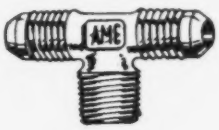
5. Tee (flare to flare to flare)

FIGURE 117



6. Tee (flare to flare to male pipe)

FIGURE 118



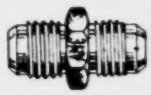
INFORMATION SHEET

7. Reducing tee (flare to flare to flare)

FIGURE 119

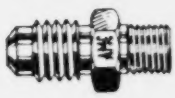
8. Union (flare to flare)

FIGURE 120



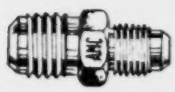
9. Half union (flare to male pipe)

FIGURE 121



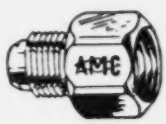
10. Reducing union (flare to reducing flare)

FIGURE 122



11. Female coupling (flare to female pipe)

FIGURE 123



C. Compression fittings (Figures 124-133)

1. Compression nut

FIGURE 124

2. Ferrule or sleeve

FIGURE 125

INFORMATION SHEET

3. Elbow (compression pipe to compression pipe)

FIGURE 126

4. Elbow (male pipe to compression pipe)

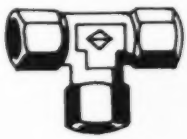
FIGURE 127

5. Elbow (female pipe to compression pipe)

FIGURE 128

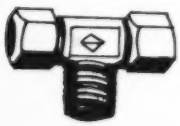
6. Tee (compression pipe to compression pipe to compression pipe)

FIGURE 129



7. Tee (compression pipe to compression pipe to male pipe)

FIGURE 130



8. Union (compression pipe to compression pipe)

FIGURE 131

9. Connection (male pipe to compression pipe)

FIGURE 132

10. Female coupling (female pipe to compression pipe)

FIGURE 133

PLUMBING MATERIALS
UNIT I

TEST

NAME _____ SCORE _____

1. Match terms associated with plumbing materials to their definitions. Write the correct numbers in the blanks.

_____a. Rigid plastic pipe

_____b. Lacking brittleness

_____c. Pipe which comes in a roll and uses slip-in fittings with clamps

_____d. Laws and regulations which stipulate type, size, and quality of pipe material to use

_____e. Short piece of threaded pipe 12 inches or less in length

_____f. Fluid-carrying pipe which has a thin wall

_____g. To coat metal with zinc by hot dipping in order to prevent rusting

_____h. Type of fitting which joins pipes of different materials

_____i. Fitting used to reduce pipe size

_____j. Designed to withstand specified pressure

_____k. That space which the pipe requires in the fitting

_____l. Loosely woven hemp rope which has been treated with a waterproofing substance and is used to make caulked joints in cast iron pipe systems

_____m. Female pipe thread

_____n. Male pipe thread

_____o. Substitute for pipe compound

_____p. Inflexible

1. Tube
2. Galvanize
3. Plumbing code
4. Malleable
5. PVC
6. Nipple
7. Flexible plastic pipe
8. Pressure fitting
9. FPT
10. Adapter
11. Fitting gain
12. MPT
13. Oakum
14. Bushing
15. Rigid
16. Thread tape

TEST

2. Select from the following list types of materials used in plumbing pipes. Write an "X" in the blank before each correct answer.

   a. Water pipes

      _____1. PVC, PE, PB

      _____2. Copper

      _____3. Cast iron

      _____4. Galvanized steel

      _____5. Brass

   b. Soil and waste

      _____1. PB plastic

      _____2. Galvanized steel

      _____3. Copper

      _____4. Ceramic tile

      _____5. Cast iron

3. Select from the following list types of pipe used in plumbing. Write an "X" in the blank before each correct answer.

   _____a. Black steel

   _____b. Galvanized steel

   _____c. Cast iron

   _____d. Brick

   _____e. PDT plastic

   _____f. PE plastic

   _____g. Ivory

   _____h. Copper

   _____i. Wood

   _____j. Vitrified clay

TEST

4. Match the identification colors on the right with the correct types of copper pipe. Write the correct numbers in the blanks.

_____a. L-soft	1. Yellow
_____b. K-soft	2. Red
_____c. DWV-Rigid	3. Blue
_____d. K-Rigid	4. Green
_____e. M-Rigid	
_____f. L-Rigid	

5. Distinguish between black steel and galvanized steel pipe by placing an "X" next to the descriptions of galvanized steel pipe.

_____a. Used for applications with corrosive liquids such as water

_____b. Limited to use with noncorrosive substances, such as gas, air, and steam

_____c. Varnished black to help prevent rust

_____d. Hot dipped in zinc to resist rusting

6. List two advantages and two disadvantages of plastic pipe.

a. Advantages

1) _____

2) _____

b. Disadvantages

1) _____

2) _____

TEST

7. Match materials used to make plumbing fittings with their specific uses, types, and properties. Write the correct numbers in the blanks.

_____a. Uses—drains, sewers, and vents; types—hub and spigot, and no-hub; properties—very brittle, cannot withstand rough treatment, rigid, heavy, needs strong support base

_____b. Uses—water services and distribution, drainage (above ground), vents, and gas (LPG); types—wrought and cast (brass); properties—fairly malleable, rigid, and lightweight, needs light support

_____c. Uses—drains, vents, water services, and irrigation; common types—PVC (polyvinyl chloride), PE (polyethylene), and PB (polybutylene); properties—very malleable, PVC is fairly rigid, PE is fairly flexible, and lightweight, needs light support

_____d. Uses—gas pipe (black), water service and distribution (galvanized); types—black iron and galvanized; properties—fairly malleable, rigid, heavy, needs strong support or base, and tends to rust

_____e. Uses—gas lines, water services and distribution; types—compression and flare; properties—fairly malleable, rigid, and lightweight, needs little support

_____f. Uses—house sewer and city sewer; type—hub (bell) and spigot, plain end with coupling; properties—very brittle, cannot withstand rough treatment, rigid, and medium weight

1. Plastic
2. Malleable cast iron
3. Cast iron
4. Vitrified clay
5. Copper
6. Brass

TEST

8. Identify basic plumbing branches. Write the correct names in the blanks.

Female adapter	**Tee**	**Sanitary tee**
Double wye	**Test tee**	**Double tapped tee**
Double tee	**Double sanitary tee**	**Tapped tee**
Wye	**Long turn sanitary tee**	**Male adapter**

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

TEST

j. _____ k. _____ l. _____

9. Identify basic plumbing bends. Write the correct names in the blanks.

Drop ear elbow
1/8 bend
1/5 bend

Adapter elbow
1/4 bend
1/16 bend

Street elbow
1/6 bend

a. _____ b. _____ c. _____

d. _____ e. _____ f. _____

g. _____ h. _____

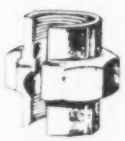
TEST

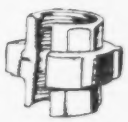
10. Identify basic unions and couplings. Write the correct names in the blanks.

Dielectric union
Gasket type union
Straight union

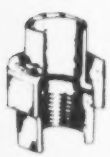
Reducing coupling (bell reducer)

Straight coupling
Ground joint union





a. _____ b. _____ c. _____



d. _____ e. _____ f. _____

11. Identify the following basic caps and plugs. Write the correct names in the blanks.

Cored plug
Solid plug

Cast iron cap

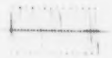
a. _____ b. _____

c. _____

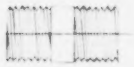
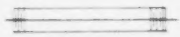
TEST

12. Identify the following basic bushings and nipples. Write the correct names in the blanks.

Long nipple
Copper bushing
Malleable cast iron bushing
Close nipple
Shoulder nipple



a. _____ b. _____ c. _____

d. _____ e. _____

13. Identify the following basic closet flanges and cleanouts. Write the correct names in the blanks.

PVC clost flange
Copper cleanout
Cast iron cleanout
No-hub slot and notch closet flange

a. _____ b. _____

c. _____ d. _____

TEST

14. Identify the following basic no-hub fittings. Write the correct names in the blanks.

Long turn 1/4 bend **Wye** **Sanitary tee**

a. _____ b. _____ c. _____

15. Identify the following flexible plastic (PE) insert fittings. Write the correct names in the blanks.

Male adapter
Tapped tee
90° female adapter

Clamp
90° elbow
Tee

Coupling
Male steel adapter

a. _____ b. _____ c. _____

d. _____ e. _____ f. _____

g. _____ h. _____

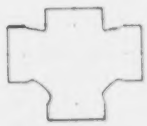
TEST

16. Identify the following PVC-DWV fittings. Write the correct names in the blanks.

Double wye
Two-way cleanout
Long sweep 1/4 bend with side inlet
P-trap with union
Double sanitary tee
Horizontal twin tee
Trap adapter
1/8 bend, street
Vent tee
Double 1/4 bend
Cleanout tee
Double 1/4 bend
P-trap
Upright wye
Coupling
Long sweep 1/4 bend with low heel inlet
Sanitary tee with left side inlet
Combination wye and 1/8 bend
Hub adapter
No-hub adapter
P-trap with cleanout
Closet flange

a. _____

b. _____

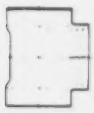


c. _____

d. _____

e. _____

f. _____



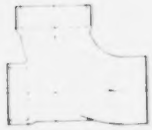
g. _____

h. _____

i. _____

TEST

j. _____



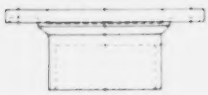
k. _____

l. _____

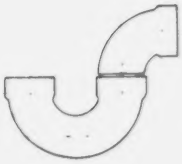
m. _____

n. _____

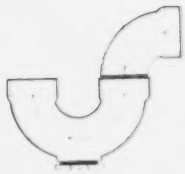
o. _____



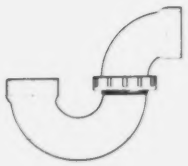
p. _____



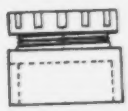
q. _____



r. _____



s. _____



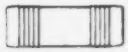
t. _____

TEST

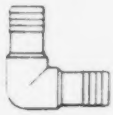
17. Identify the following polybutylene fittings. Write the correct names in the blanks.

Insert coupling
Compression ring
Insert tee
Insert plug
Insert male adapter
Insert elbow
Reducer tee

a. _____

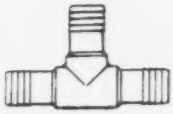


b. _____



c. _____

d. _____



e. _____

f. _____

18. Distinguish between the two types of threaded malleable iron fittings (drainage and pressure) by placing an "X" next to the description of drainage fittings.

_____a. Used for water vent lines

_____b. Used for gas and air vent lines

_____c. Used for drainage lines

_____d. Tapped with a pitch of 1/4 inch per foot

_____e. Insides smooth and shaped for easy flow

TEST

19. Select types of adapters from the following list. Write an "X" in the blank before each correct answer.

_____a. Copper to cast iron (caulked)

_____b. Copper to threaded pipe

_____c. Copper to PVC

_____d. PVC to vitrified clay

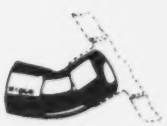
_____e. PVC to cast iron

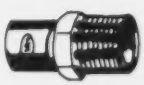
_____f. PVC to threaded pipe

20. Identify the following copper tubing fittings. Write the correct names in the blanks.

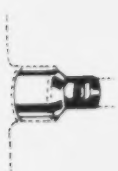
a. Sweat-type fittings

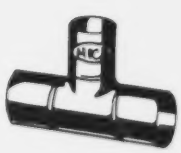
Coupling
Reducer
90° elbow
Tee
Flush bushing
45° street elbow
Female fitting adapter
Male adapter





1. _____ 2. _____ 3. _____





4. _____ 5. _____ 6. _____

TEST

7. _____ 8. _____

b. Flare-type fittings

Reducing tee
Female coupling
Flare nut

Street elbow
Tee
Union

Half union
Reducing union
Elbow

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

TEST

c. Compression fittings

(NOTE: Some answers may be used more than once.)

Tee	**Union**	**Female coupling**
Ferrule or sleeve	**Connection**	
Elbow	**Compression nut**	

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

7. _____ 8. _____ 9. _____

PLUMBING MATERIALS
UNIT I

ANSWERS TO TEST

1.

a. 5	e. 6	i. 14	m. 9
b. 4	f. 1	j. 8	n. 12
c. 7	g. 2	k. 11	o. 16
d. 3	h. 10	l. 13	p. 15

2. a. 1, 2, 4
   b. 2, 3, 5

3. a, b, c, f, h, j

4.

a. 3	c. 1	e. 2
b. 4	d. 4	f. 3

5. a, d

6. Answer should include any two advantages and two disadvantages.

   a. Advantages

      1) Lightweight
      2) Resists corrosion and electrolysis
      3) Easily installed
      4) Comparatively inexpensive

   b. Disadvantages

      1) Will not withstand temperatures over 150 degrees Fahrenheit
      2) Not stable at pressures over 100 psi

7.

a. 3	c. 1	e. 6
b. 5	d. 2	f. 4

8.

a. Tee	g. Double sanitary tee
b. Double tee	h. Test tee
c. Tapped tee	i. Wye
d. Double tapped tee	j. Double wye
e. Sanitary tee	k. Male adapter
f. Long turn sanitary tee	l. Female adapter

ANSWERS TO TEST

9. a. 1/4 bend
   b. 1/5 bend
   c. 1/6 bend
   d. 1/8 bend
   e. 1/16 bend
   f. Street elbow
   g. Adapter elbow
   h. Drop ear elbow

10. a. Straight union
    b. Dielectric union
    c. Ground joint union
    d. Gasket-type union
    e. Straight coupling
    f. Reducing coupling (bell reducer)

11. a. Cast iron cap
    b. Cored plug
    c. Solid plug

12. a. Copper bushing
    b. Malleable cast iron
    c. Close nipple
    d. Shoulder nipple
    e. Long nipple

13. a. No-hub slot and notch closet flange
    b. PVC closet flange
    c. Copper cleanout
    d. Cast iron cleanout

14. a. Wye
    b. Sanitary tee
    c. Long turn 1/4 bend

15. a. Tee
    b. Tapped tee
    c. 90° elbow
    d. 90° female adapter
    e. Coupling
    f. Male adapter
    g. Male steel adapter
    h. Clamp

16. a. Upright wye
    b. Sanitary tee with left side inlet
    c. Double sanitary tee
    d. Two-way cleanout
    e. Vent tee
    f. Double wye
    g. Cleanout tee
    h. Combination wye and 1/8 bend
    i. Double 1/4 bend
    j. Long sweep 1/4 bend with side inlet
    k. Long sweep 1/4 bend with low heel inlet
    l. Coupling
    m. 1/8 bend, street
    n. No-hub adapter
    o. Hub adapter
    p. Closet flange
    q. P-trap
    r. P-trap with cleanout
    s. P-trap with union
    t. Trap adapter

ANSWERS TO TEST

17. a. Insert male adapter
    b. Insert coupling
    c. Insert elbow
    d. Insert plug
    e. Insert tee
    f. Reducer tee

18. c, d, e

19. a, b, e, f

20. a. 1. 45° street elbow
    2. Male adapter
    3. Flush bushing
    4. Reducer
    5. Tee
    6. Female fitting adapter
    7. 90° elbow
    8. Coupling

    b. 1. Union
    2. Street elbow
    3. Female coupling
    4. Elbow
    5. Reducing union
    6. Tee
    7. Flare nut
    8. Reducing tee
    9. Half union

    c. 1. Female coupling
    2. Elbow
    3. Tee
    4. Ferrule or sleeve
    5. Union
    6. Elbow
    7. Connection
    8. Compression nut
    9. Tee

PLUMBING TOOLS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify tools used by plumbers and should be able to state guidelines pertaining to proper care and safe use of the tools. The student will show this ability by completing the unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with plumbing tools.
2. Match types of screwdrivers to their uses.
3. Match types of wrenches to their uses.
4. Match types of pliers to their uses.
5. Match types of hammers to their uses.
6. Match types of chisels, punches and bars to their uses.
7. Match types of files to their uses.
8. Match types of socket wrenches and their accessories to their uses.
9. Match types of tubing tools to their uses.
10. Match types of cutting and threading tools used on iron pipe to their uses.
11. Identify types of cast iron pipe cutters.
12. Identify types of cast iron pipe assembly tools.
13. Identify types of miscellaneous hand tools.
14. State guidelines for proper care and safe use of hand tools.
15. Identify types of power tools used by plumbers.
16. State guidelines for proper care and safe use of power tools.
17. Identify types of testing equipment.
18. Identify types of torches and their accessories used by plumbers.
19. State guidelines for proper care and safe use of testing equipment and torches.

PLUMBING TOOLS
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Test

E. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Tool catalogs

(NOTE: Obtain several tool catalogs and display for students to review.)

2. Newspaper clippings or case studies that relate to safe tool use

3. Poster of safety rules for each stationary tool

C. Introduce unit to students.

- Ask students to review tool catalogs; discuss hand tools, pointing out the importance of buying good grades of tools. Tell students that quality, not price, should be their main concern when buying tools.
- Emphasize the convenience of power tools while stressing the fact that the use of power tools places on the student an even greater responsibility to be careful.
- Tour the shop area, pointing out tools that the students will be studying and demonstrate uses of those tools.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing the care and safe use of tools.

F. Provide students with information sheet.

SUGGESTED ACTIVITIES

G. Discuss information sheet.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with plumbing tools.

   - Discuss, demonstrate and use actual examples of terms that may be unfamiliar to the students.

2. Use Information Sheet, Sections II through XIV to discuss hand tools and their uses.

   - Display samples of the various hand tools discussed in the sections of the information sheet.
   - Discuss proper use of each of the tools.
   - Allow students to handle the tools so that they can become familiar with them.
   - Demonstrate the use of the various hand tools.
   - Caution students about using tools only for their intended purpose.
   - Stress the importance of proper care and safe use of hand tools.

3. Use Information Sheet, Sections XV and XVI to discuss types of power tools, proper care and safe use of the tools.

   - Display samples or illustrations of the various power tools discussed in sections of the information sheet.
   - Allow students to handle the tools so that they can become familiar with them.
   - Discuss proper and safe use of the tools.
   - Caution students about not using each power tool until they have been properly trained and certified in its use.
   - Make a display of accident report forms and safety posters.
   - Have plumbers who have been injured by power tools talk to the class about their accidents.
   - Remind students to use the correct tool for the job being done.
   - After each student has been trained in the proper use of power tools, have them demonstrate the correct operation of power tools, using other students to critique the performance.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Sections XVII through XIX to discuss types of testing equipment and torches used by plumbers and proper care and safe use of this equipment.

   - Display samples or illustrations of various types of testing equipment and torches and accessories discussed in sections of the information sheet.
   - Allow students to handle the equipment so that they can become familiar with it.
   - Discuss how the equipment and accessories are used.
   - Demonstrate the use of the various pieces of equipment that are available to you.
   - Caution students about not using this equipment until they have been trained in its use.
   - After each student has been trained, have them demonstrate the correct operation of the equipment, using other students to critique the performance.
   - Discuss safety precautions pertaining to gas and gas equipment.
   - Discuss the various uses for air-acetylene and air-propane torches.
   - Demonstrate the use of the torches.
   - Have students review the guidelines for proper care and safe use of testing equipment and torches in the information section of this unit.

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate section of the competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to the students as needed.)

III. Unit reference — Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.

PLUMBING TOOLS
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with plumbing tools

A. **Hand tool** — Hand held and not operated by electricity, air, or gasoline

B. **Power tool** — Operated with electricity, air, or gasoline

C. **Specialized tool** — Designed for a particular use

D. **Threading** — Method of developing spiral cuts on pipe in order to facilitate joining

E. **Male/female** — Designates joints of pipe in reference to the fittings; female fitting receives the male pipe

F. **Reciprocating** — Moving in a back and forth motion, as opposed to a circular motion

G. **Abrasive** — Cutting and grinding of material by a thin wheel made of a hard stone-like substance

H. **Flare nut** — Fitting used on tubing; when screwed in place fits tightly against the flare of tubing to seal the joint

I. **Acetylene** — A colorless, gaseous hydrocarbon made by the action of water on calcium carbide; used as a fuel

J. **Pitch** — Slope or grade given to a horizontal run of pipe to permit gravity flow of liquid

K. **Propane** — A heavy, flammable, gaseous, paraffin hydrocarbon found in crude petroleum and natural gas; used as a fuel

L. **Manometer** — An instrument used to measure the pressure of gases and vapors

II. Types of screwdrivers and their uses (Figures 1-4)

A. Standard — Used for tightening or loosening bolts and screws with slot-type head

EXAMPLE:

FIGURE 1

INFORMATION SHEET

B. Phillips — Used for tightening or loosening bolts and screws with phillips-type head

EXAMPLE:

FIGURE 2

C. Clutch head — Used for tightening or loosening bolts or screws with clutch-type head

EXAMPLE:

FIGURE 3

D. Offset — Used in extremely close quarters

EXAMPLE:

FIGURE 4

III. Types of wrenches and their uses (Figures 5-8)

A. Pipe — Primarily for tightening or loosening pipe and fittings

EXAMPLE:

FIGURE 5

INFORMATION SHEET

B. Chain — Used to hold, tighten, or loosen pipes and fittings

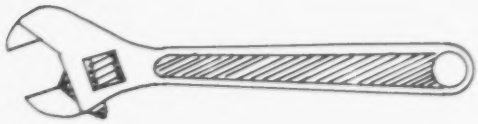
EXAMPLE:

FIGURE 6

C. Adjustable — For tightening or loosening various sizes and types of nuts, bolts, and fittings

EXAMPLE:

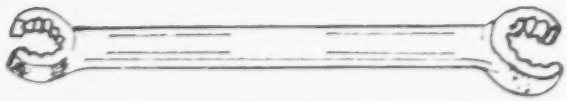
FIGURE 7



D. Flare nut — For tightening or loosening flare nuts; it has a box end with a notch cut out so that it can be slipped over the tubing

EXAMPLE:

FIGURE 8



INFORMATION SHEET

IV. Types of pliers and their uses (Figures 9-13)

A. Slip joint — Used to hold or turn a part where marring of the surface is not a problem

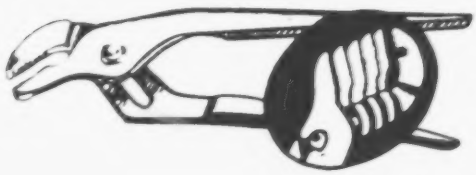
EXAMPLE:

FIGURE 9

B. Channel lock — Used to hold or turn large parts where marring of the surface is not a problem and more leverage is needed

EXAMPLE:

FIGURE 10



C. Long nose — For holding or retrieving small objects in tight places

EXAMPLE:

FIGURE 11

INFORMATION SHEET

D. Diagonal cutter — For cutting wire

EXAMPLE:

FIGURE 12

E. Lock grip — For excessively tight grip; has a locking lever to prevent slipping

EXAMPLE:

FIGURE 13

V. Types of hammers and their uses (Figures 14-17)

A. Ball peen — For striking punches and chisels

EXAMPLE:

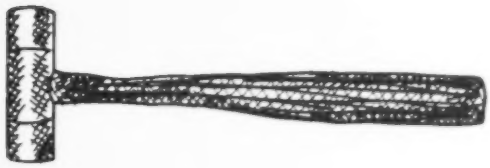
FIGURE 14

INFORMATION SHEET

B. Soft face — Used on soft materials where steel hammers would be impractical

EXAMPLE:

FIGURE 15

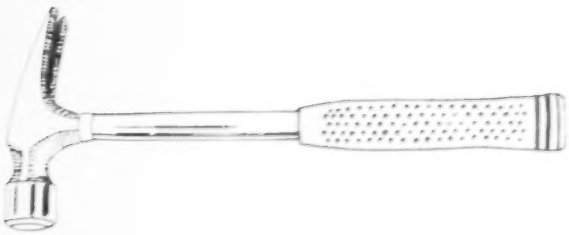


(NOTE: Soft face hammers are made of plastic, wood, rubber, rawhide, lead, or copper.)

C. Claw — Generally used to drive and pull nails

EXAMPLE:

FIGURE 16



D. Sledge — For driving stakes, breaking, and pounding

EXAMPLE:

FIGURE 17

INFORMATION SHEET

VI. Types of chisels, punches, bars, and their uses (Figures 18-23)

A. Flat chisel — Used to cut metal and concrete

EXAMPLE:

FIGURE 18

B. Bullnose chisel — Used for chipping and breaking concrete

EXAMPLE:

FIGURE 19

C. Wood chisel — Used for cutting notches and holes in wood for pipe

EXAMPLE:

FIGURE 20

D. Pin punch — For driving straight and tapered pins in or out of hubs and shafts

EXAMPLE:

FIGURE 21

INFORMATION SHEET

E. Center punch — Used to make indentations in metal for starting drills

EXAMPLE:

FIGURE 22

F. Pry bar — Generally for jobs that require prying an object into alignment

EXAMPLE:

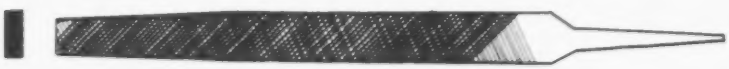
FIGURE 23

VII. Types of files and their uses (Figures 24-27)

A. Flat — Double-cut file used to smooth metal surfaces and remove burrs

EXAMPLE:

FIGURE 24



B. Round — Used to enlarge round holes

EXAMPLE:

FIGURE 25

INFORMATION SHEET

C. Triangular — Used for repairing damaged threads and enlarging small square holes

EXAMPLE:

FIGURE 26

D. Half round — Used to smooth rounded surfaces and enlarge round holes

EXAMPLE:

FIGURE 27

VIII. Types of socket wrenches, their accessories, and their uses (Figures 28-34)

(NOTE: Socket sets are made in sizes from 1/4-inch drive to 1-inch drive.)

A. Standard socket — Used with a drive handle to tighten or loosen hex head bolts and nuts

EXAMPLE:

FIGURE 28

INFORMATION SHEET

B. Deep socket — Used with a drive handle to tighten or loosen bolts and nuts that are recessed or where bolts extend through the nut so far that a standard socket will not fit over them

EXAMPLE:

FIGURE 29

C. Universal joint — Designed to fit between socket and drive handle; swivels in any direction enabling the socket to get to hard-to-reach nuts and bolts

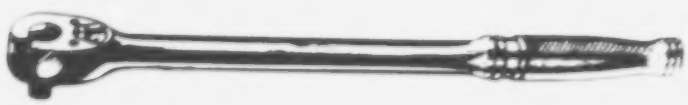
EXAMPLE:

FIGURE 30

D. Ratchet handle — Drive handle designed so it can be used in either direction with very little swinging space

EXAMPLE:

FIGURE 31



E. Flex or hinge handle (breaker bar) — Drive handle used with sockets on bolts and nuts where more leverage is needed

EXAMPLE:

FIGURE 32

INFORMATION SHEET

F. Extension — Rod that fits between socket and drive handle; used to extend the socket into hard-to-reach places

(NOTE: Extensions are made in various lengths.)

EXAMPLE:

FIGURE 33

G. Speed handle — Drive handle designed for speed; used with a socket to tighten or loosen easy-to-reach bolts and nuts

EXAMPLE:

FIGURE 34

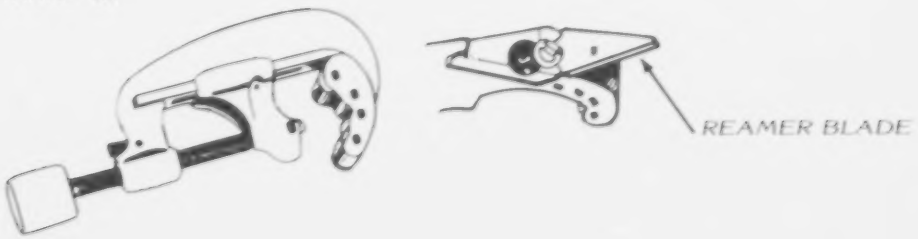
IX. Types of tubing tools and their uses (Figures 35-38)

A. Tubing cutter — Designed to cut tubing by advancing blade into the tubing while rotating the cutter at the same time

(NOTE: Tubing cutters are made in various sizes.)

EXAMPLE:

FIGURE 35

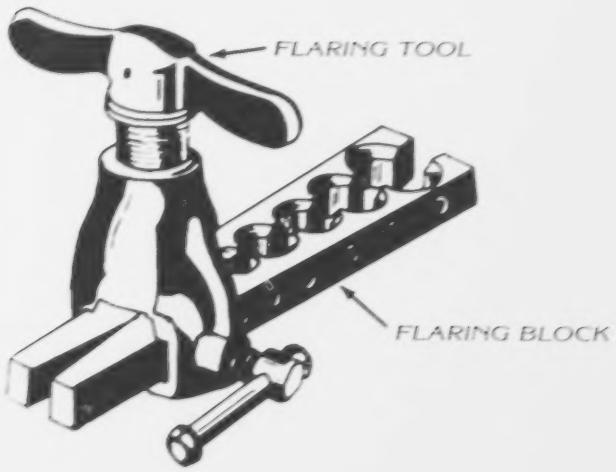


INFORMATION SHEET

B. Flaring tool — Designed to create a flare on the end of tubing by forcing a 45° cone into the end of tubing being held in the flaring block

EXAMPLE:

FIGURE 36

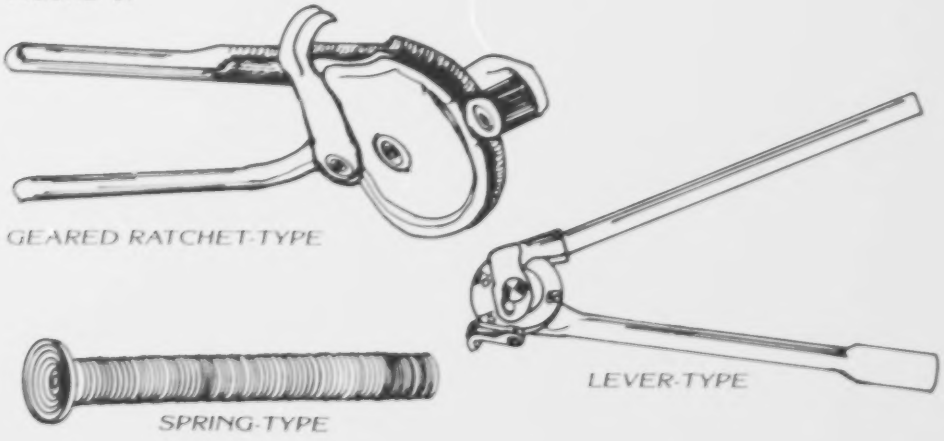


C. Flaring block — Designed to hold tubing in the correct position while it is being flared or swaged (See Figure 36)

D. Tubing benders — Designed to bend or shape tubing without collapsing it, so that the tubing will fit in the position where it is needed

EXAMPLES:

FIGURE 37



INFORMATION SHEET

E. Swage punch — Used to enlarge tubing by driving it into the end of tubing so that another tube of the same size may be slipped into it

(NOTE: Swage punches are made to fit various tubing sizes: ½", ¾", 1".)

EXAMPLE:

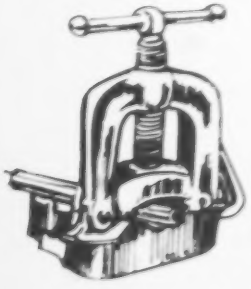
FIGURE 38

X. Types of cutting and threading tools used on iron pipe and their uses (Figures 39-43)

A. Pipe vise — Used to hold pipe while cutting, threading, reaming, and while attaching or removing fittings or sections of pipe

EXAMPLE:

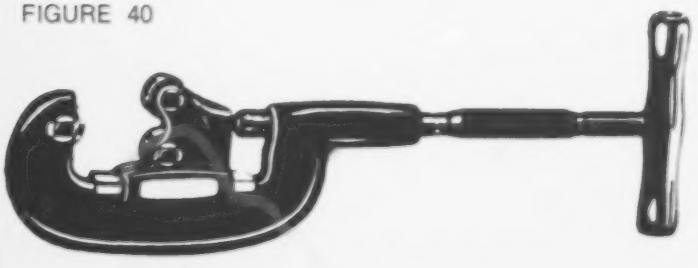
FIGURE 39



B. Pipe cutter — Used to cut iron pipe to a desired length

EXAMPLE:

FIGURE 40

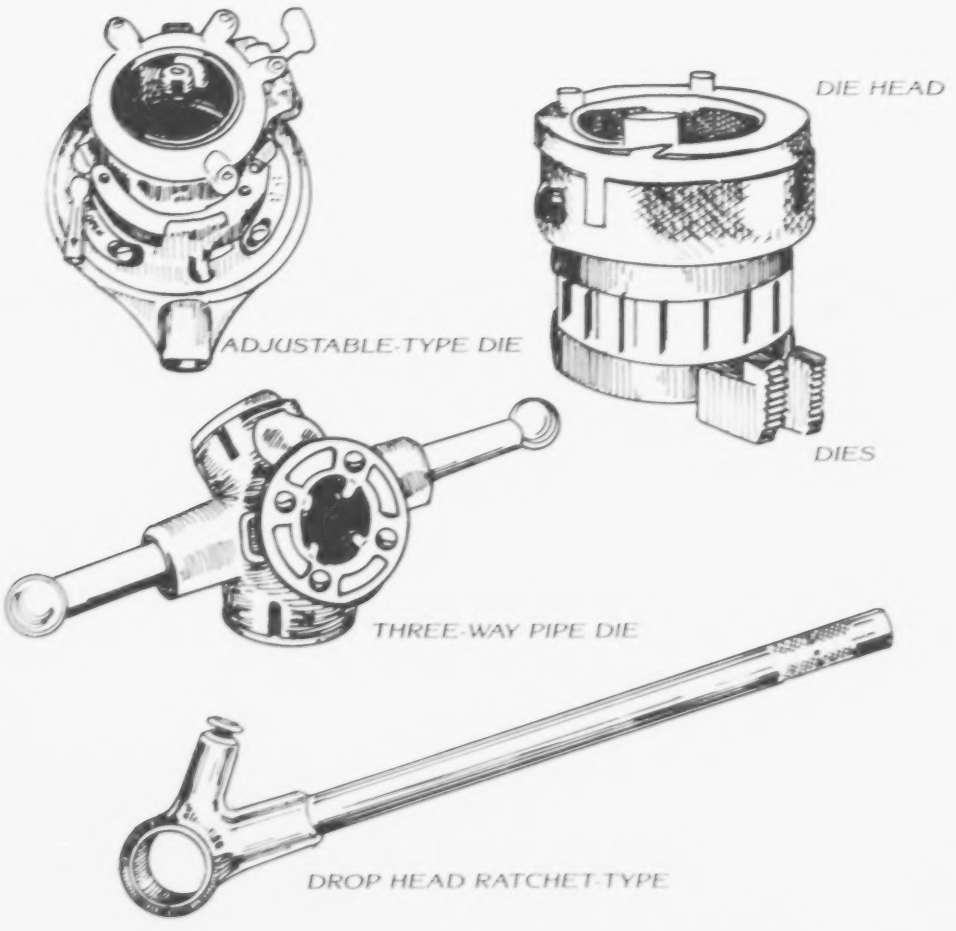


INFORMATION SHEET

C. Pipe dies and heads — Used for cutting external threads on pipe

EXAMPLES:

FIGURE 41

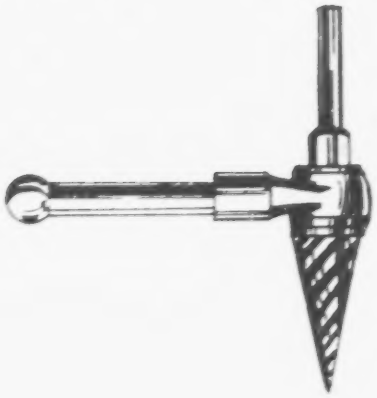


INFORMATION SHEET

D. Pipe reamer — Used to remove burrs from inside edge of pipe

EXAMPLE:

FIGURE 42

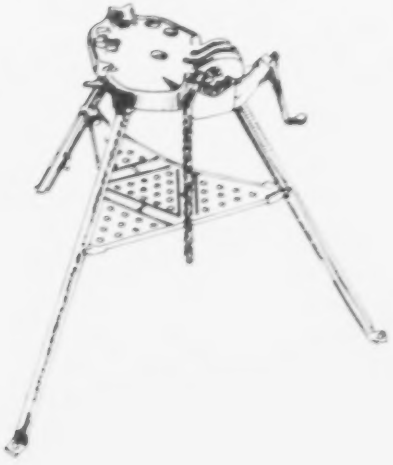


E. Vise stand — For holding pipe while cutting and threading

(NOTE: Some stands also have pipe benders built on them.)

EXAMPLE:

FIGURE 43

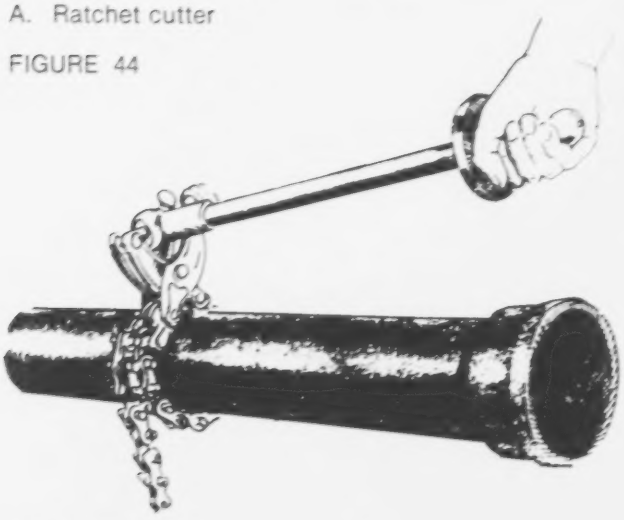


INFORMATION SHEET

XI. Types of cast iron pipe cutters (Figures 44-47)

A. Ratchet cutter

FIGURE 44

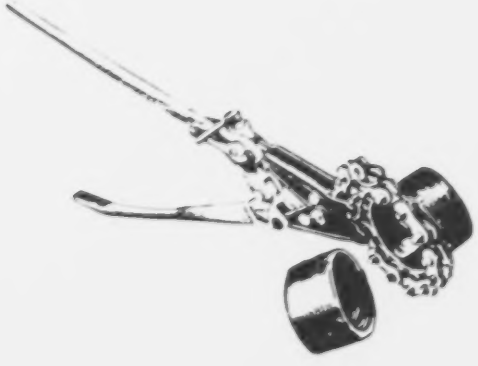


B. Hydraulic cutter

FIGURE 45

C. Squeeze-type cutter

FIGURE 46



INFORMATION SHEET

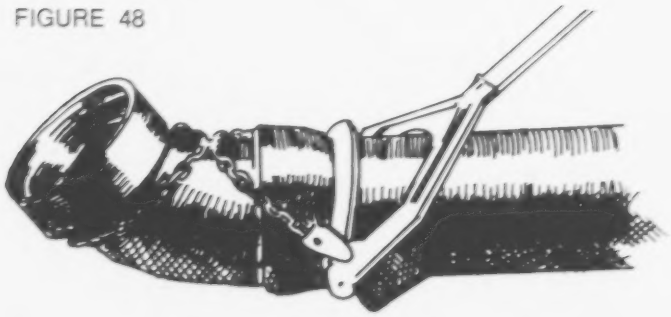
D. Hammer and chisel

FIGURE 47

XII. Types of cast iron pipe assembly tools (Figures 48-50)

A. Pipe puller

FIGURE 48



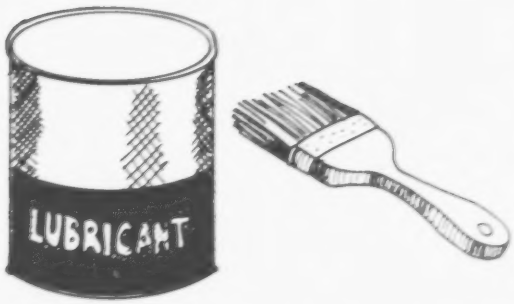
B. Lead hammer (used to assemble rubber-gasket-type soil pipe)

FIGURE 49

INFORMATION SHEET

C. Pipe lubricant and brush

FIGURE 50



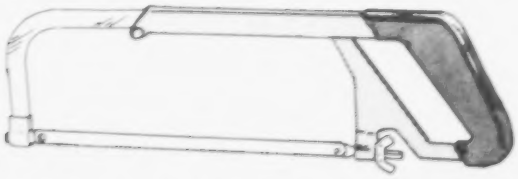
XIII. Miscellaneous hand tools and their uses (Figures 51-55)

A. Basin wrench — Used to loosen and tighten fittings under fixtures

FIGURE 51

B. Hack saw — Used for cutting metal

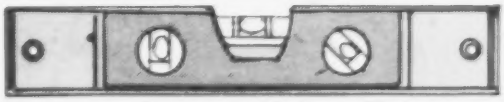
FIGURE 52



C. Level — For checking level and plumb of fixtures and the pitch of pipe

FIGURE 53

UTILITY LEVEL

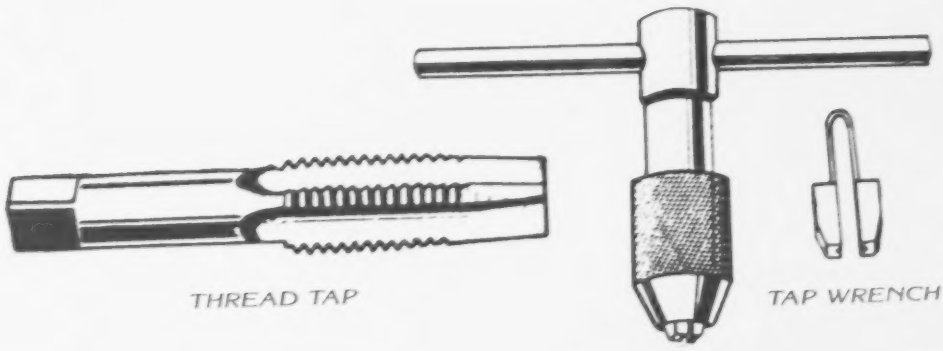


TORPEDO LEVEL

INFORMATION SHEET

D. Thread tap and tap wrench — Used to cut interior threads; the handle is used to hold the tap during threading process

FIGURE 54



E. Hex key wrenches — For loosening or tightening socket-type set screws and for faucet repairs

FIGURE 55

XIV. Guidelines for proper care and safe use of hand tools

A. Use good quality tools

B. Use tools only for their intended purpose

C. *Never* bend or distort a rule

D. Keep moisture away from steel tapes

E. Keep cutting edges and points sharp and protected

INFORMATION SHEET

F. *Do not* hammer on screwdrivers

G. Repair or replace worn or damaged tools

H. Keep all handles tight

I. *Do not* use pliers in place of wrenches

J. Have all metal handles insulated when working on or near electrical circuits

K. *Do not* hammer or pry with files or screwdrivers

L. *Do not* use an extension pipe or cheater bar on handles of tools

M. Use oil on threading tools when cutting threads

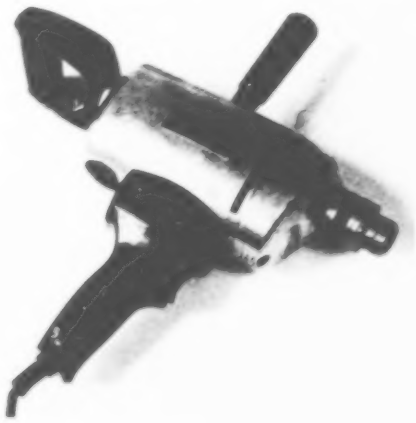
XV. Types of power tools used by plumbers (Figures 56-74)

A. ¼" drill

FIGURE 56

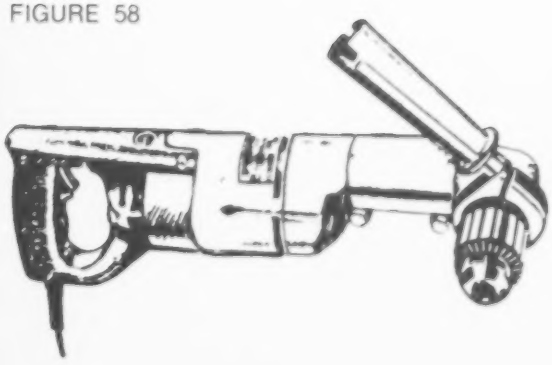
B. ½" drill

FIGURE 57



C. Angle drill

FIGURE 58



INFORMATION SHEET

D. Portable circular saw

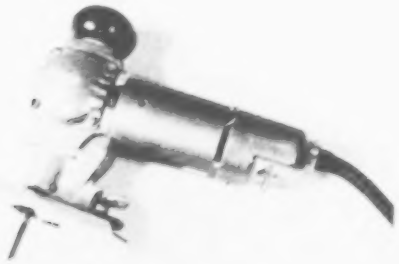
FIGURE 59

E. Reciprocating saw

FIGURE 60

F. Jig saw (saber saw)

FIGURE 61



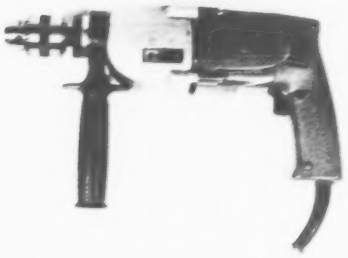
INFORMATION SHEET

G. Portable band saw

FIGURE 62

H. Rotary hammer

FIGURE 63

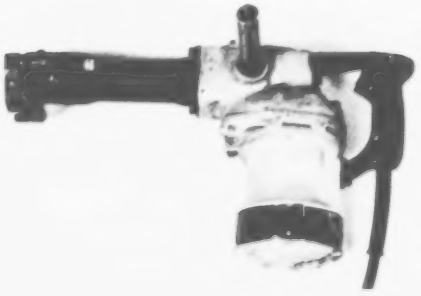


I. Hammer drill

FIGURE 64

J. Chipping hammer

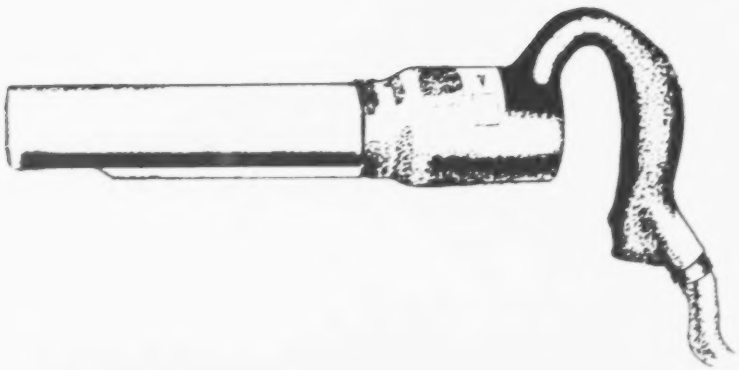
FIGURE 65



INFORMATION SHEET

K. Air hammer

FIGURE 66



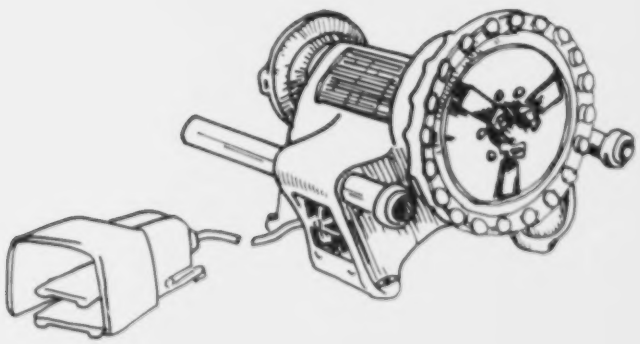
L. Powder-actuated tool

FIGURE 67

INFORMATION SHEET

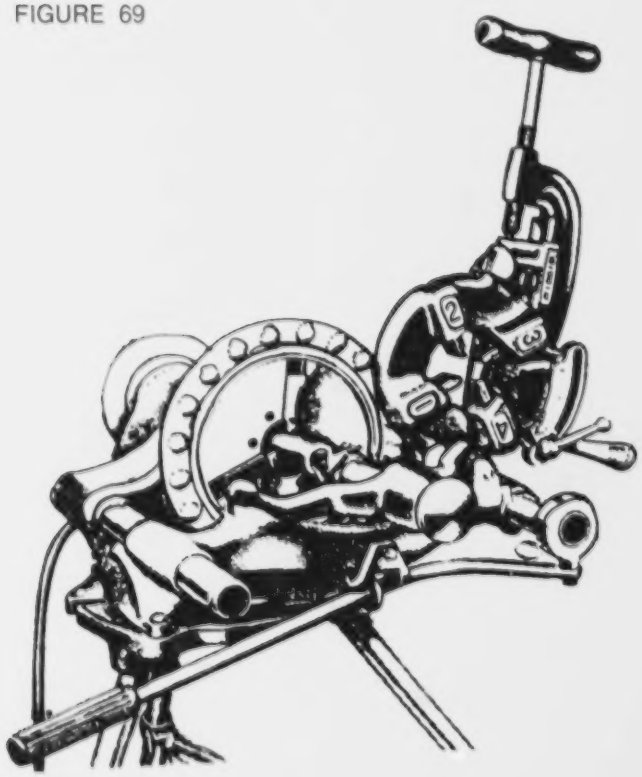
M. Portable power-driven vise stand

FIGURE 68



N. Portable electric pipe threader

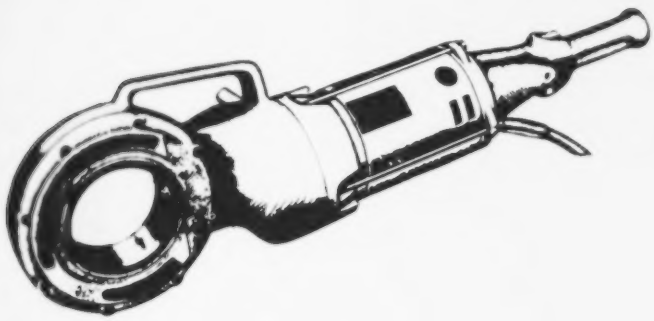
FIGURE 69



INFORMATION SHEET

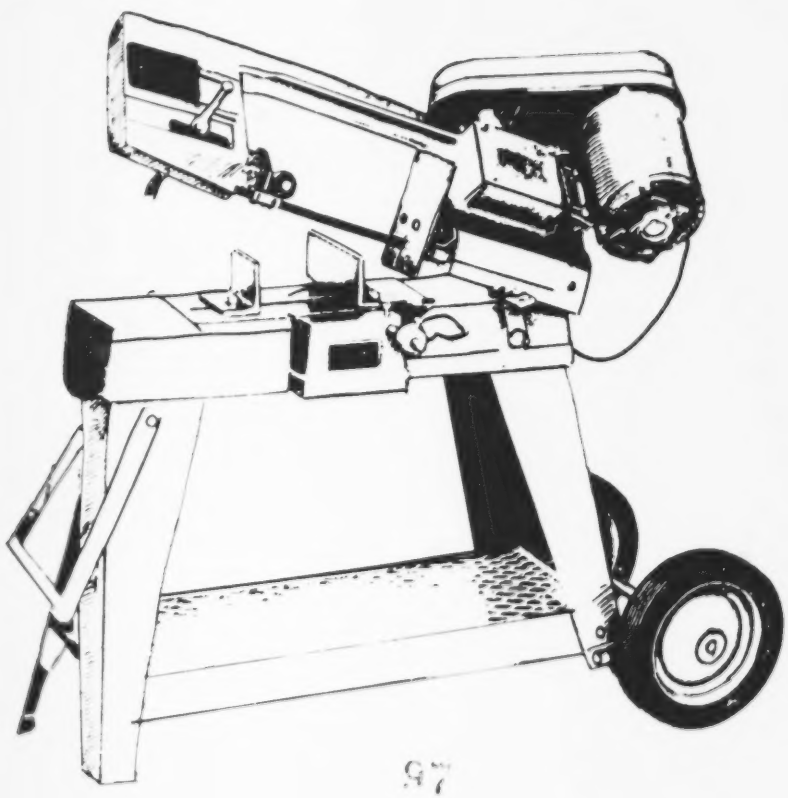
O. Portable power-driven threading machine

FIGURE 70



P. Bench band saw

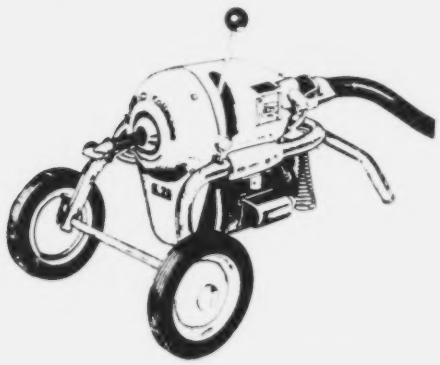
FIGURE 71



INFORMATION SHEET

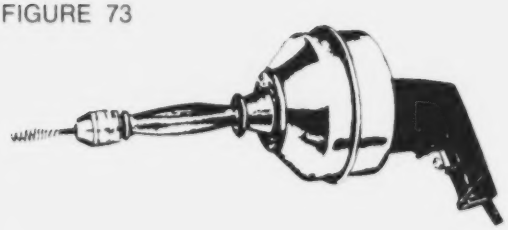
Q. Electric power drain cleaner

FIGURE 72



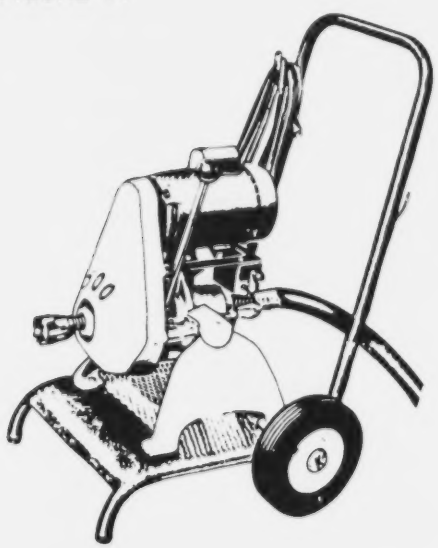
R. Electric snake

FIGURE 73



S. Compressed air or gasoline power drain cleaner

FIGURE 74



INFORMATION SHEET

XVI. Guidelines for proper care and safe use of power tools

A. Wear safety goggles

B. Know the tool you are using, its application, limitations, and potential hazards

C. Select proper tool for the job

D. Be sure all tools are grounded before using

E. *Never* remove ground plug from the equipment cord

F. Remove adjusting keys and wrenches before turning on tool

G. Keep work area free of clutter

H. *Never* operate tools with guards removed

I. Be sure saw blades, drills, and cutters are sharp, clean, and regularly maintained

J. Use only accessories recommended by the manufacturer

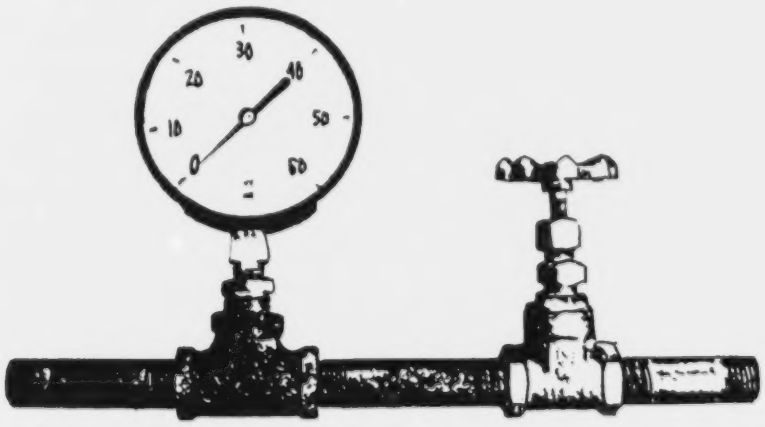
K. *Do not* force tools

L. *Never* leave tool running unattended

XVII. Types of testing equipment (Figures 75-80)

A. Test gauge assembly

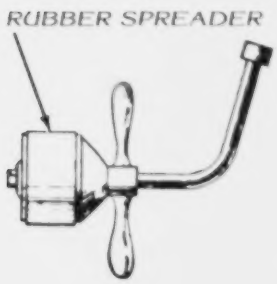
FIGURE 75



INFORMATION SHEET

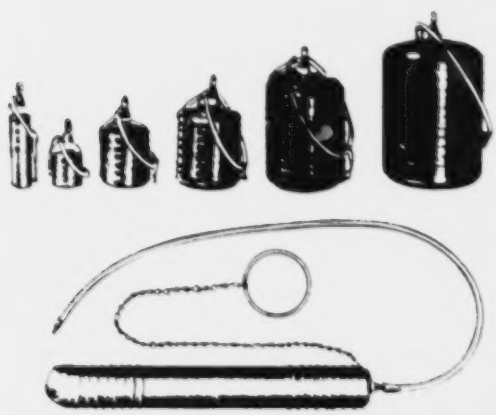
B. Mechanical test plug

FIGURE 76



C. Inflatable rubber test plugs

FIGURE 77



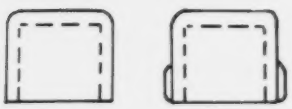
D. Test cap for threaded pipe

FIGURE 78

INFORMATION SHEET

E. Test cap for copper or plastic

FIGURE 79



F. Tire pump (used to inflate test plugs)

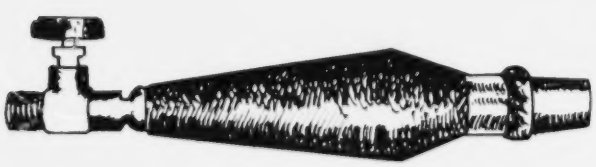
FIGURE 80

XVIII. Types of torches and accessories used by plumbers

A. Air/acetylene torch (Figures 81-87)

1. Torch handle

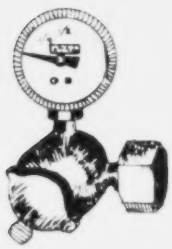
FIGURE 81



INFORMATION SHEET

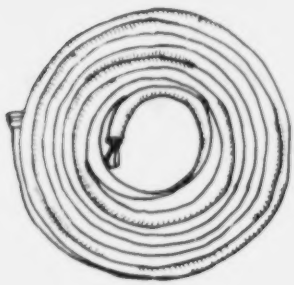
2. Regulator

FIGURE 82



3. Hose

FIGURE 83



4. Tips

FIGURE 84

VERY FINE

LARGE

FINE

EXTRA LARGE

MEDIUM

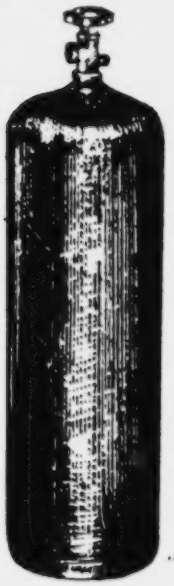
HIGH-TEMPERATURE
WRAPAROUND FLAME TIP

MEDIUM LARGE

INFORMATION SHEET

5. Acetylene tanks

FIGURE 85



"B" TANK

"MC" TANK

7. Cylinder wrench

FIGURE 86

8. Striker

FIGURE 87

B. Air/propane torch (Figures 88-95)

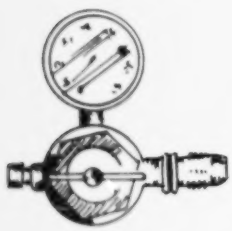
1. Torch handle

FIGURE 88

INFORMATION SHEET

2. Regulator

FIGURE 89

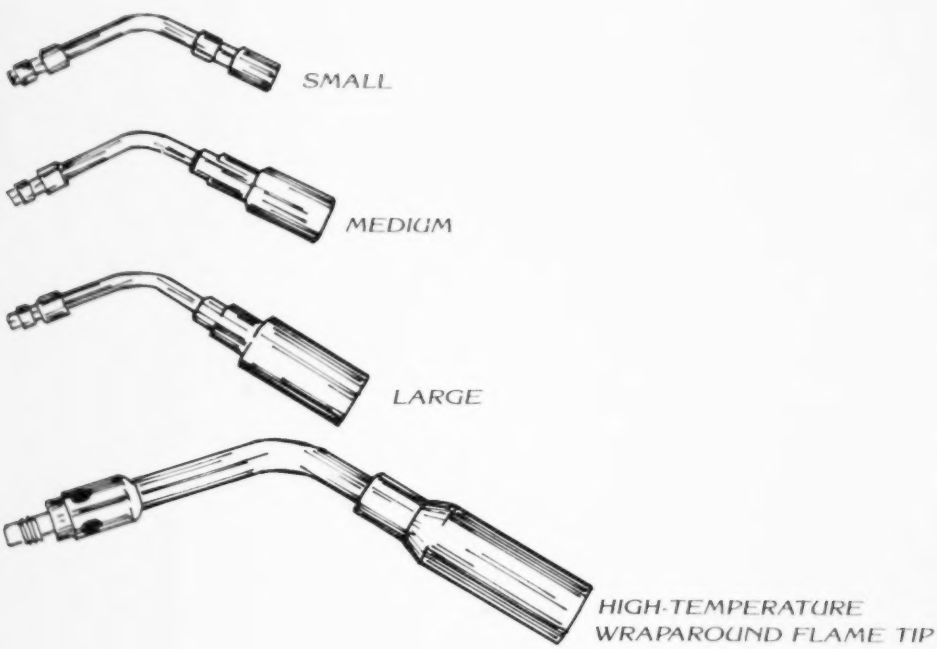


3. Hose

FIGURE 90

4. Tips

FIGURE 91

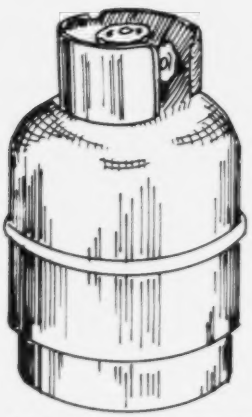


INFORMATION SHEET

5. Liquified petroleum cylinders

FIGURE 92

2 ½-POUND CYLINDER



20-POUND CYLINDER

6. Tank key

FIGURE 93

7. Striker

FIGURE 94

8. Halide torch leak detector

FIGURE 95

INFORMATION SHEET

XIX. Guidelines for proper care and safe use of testing equipment and torches

A. Protect glass on gauges from breaking

B. Keep all testing equipment clean and properly maintained

C. *Do not* overinflate test plugs

D. Keep torches and tips clean and handle carefully

E. Use proper wrenches on fuel tanks and torch tips

F. Use proper regulator on the proper cylinder

G. *Do not* force connections of hoses and regulators

H. *Do not* exceed recommended pressures

I. *Do not* attempt to repair faulty regulators

J. Test hoses for leaks prior to using; replace if damaged

K. Keep hose properly rolled and stored when not in use

L. Avoid circumstances where a hose can be rolled over, kinked, burned, or subject to falling objects or hot metals

M. *Never* use oil or grease on torches or other connections

N. Make a final inspection to be sure all connections are tight

PLUMBING TOOLS
UNIT II

TEST

NAME _____ SCORE _____

1. Match terms associated with plumbing tools to their correct definitions. Write the correct numbers in the blanks.

_____a. Operated with electricity, air, or gasoline

_____b. Hand held and not operated by electricity, air, or gasoline

_____c. Designed for a particular use

_____d. Method of developing spiral cuts on pipe in order to facilitate joining

_____e. Designates joints of pipe in reference to the fittings; female fitting receives the male pipe

_____f. Moving in a back and forth motion, as opposed to a circular motion

_____g. Cutting and grinding of material by a thin wheel made of a hard stone-like substance

_____h. Fitting used on tubing; when screwed in place fits tightly against the flare on tubing to seal the joint

_____i. A colorless, gaseous, hydrocarbon made by the action of water on calcium carbide; used as a fuel

_____j. Slope or grade given to a horizontal run of pipe to permit gravity flow of liquid

_____k. A heavy, flammable, gaseous, paraffin hydrocarbon found in crude petroleum and natural gas; used as a fuel

_____l. An instrument used to measure the pressure of gases and vapors

1. Male/female
2. Acetylene
3. Hand tool
4. Flare nut
5. Reciprocating
6. Pitch
7. Manometer
8. Power tool
9. Propane
10. Threading
11. Abrasive
12. Specialized tool

2. Match types of screwdrivers to their uses. Write the correct names in the blanks.

Standard **Offset**
Clutch head **Phillips**

_____a. Used for tightening or loosening bolts and screws with phillips-type head

_____b. Used in extremely close quarters

TEST

_____c. Used for tightening or loosening bolts and screws with slot-type head

_____d. Used for tightening or loosening bolts or screws with clutch-type head

3. Match types of wrenches to their uses. Write the correct numbers in the blanks.

_____a. For tightening or loosening various sizes and types of nuts, bolts, and fittings

_____b. Primarily for tightening or loosening pipe and fittings

_____c. For tightening or loosening flare nuts; it has a box end with a notch cut out so that it can be slipped over the tubing

_____d. Used to hold, tighten, or loosen pipes and fittings

1. Pipe
2. Chain
3. Adjustable
4. Flare nut

4. Match types of pliers to their uses. Write the correct numbers in the blanks.

_____a. Used to hold or turn large parts where marring of the surface is not a problem and more leverage is needed

_____b. For cutting wire

_____c. Used to hold or turn a part where marring of the surface is not a problem

_____d. For excessively tight grip; has a locking lever to prevent slipping

_____e. For holding or retrieving small objects in tight places

1. Slip joint
2. Channel lock
3. Long nose
4. Diagonal cutter
5. Lock grip

5. Match types of hammers to their uses. Write the correct names in the blanks.

Ball peen **Claw**
Soft face **Sledge**

_____a. For striking punches and chisels

_____b. For driving stakes, breaking, and pounding

_____c. Used on soft materials where steel hammers would be impractical

_____d. Generally used to drive and pull nails

TEST

6. Match types of chisels, punches, and bars to their uses. Write the correct numbers in the blanks.

_____a. Generally for jobs that require prying an object into alignment

_____b. Used for chipping and breaking concrete

_____c. For driving straight or tapered pins in or out of hubs and shafts

_____d. Used to make indentations in metal for starting drills

_____e. Used for cutting notches and holes in wood for pipe

_____f. Used to cut metal and concrete

1. Flat chisel
2. Bullnose chisel
3. Wood chisel
4. Pin punch
5. Center punch
6. Pry bar

7. Match types of files to their uses. Write the correct names in the blanks.

Flat **Triangular**
Round **Half round**

_____a. Used for repairing damaged threads and enlarging small square holes

_____b. Used to enlarge round holes

_____c. Double-cut file used to smooth metal surfaces and remove burrs

_____d. Used to smooth rounded surfaces and enlarge round holes

8. Match types of socket wrenches and their accessories to their uses. Write the correct numbers in the blanks.

_____a. Used with a drive handle to tighten or loosen bolts and nuts that are recessed or where bolts extend through the nut so far that a standard socket will not fit over them

_____b. Drive handle used with sockets on bolts and nuts where more leverage is needed

_____c. Designed to fit between socket and drive handle; swivels in any direction enabling the socket to get to hard-to-reach nuts and bolts

1. Standard socket
2. Deep socket
3. Universal joint

TEST

_____d. Drive handle designed for speed; used with a socket to tighten or loosen easy-to-reach bolts and nuts

_____e. Used with a drive handle to tighten or loosen hex head bolts and nuts

_____f. Rod that fits between socket and drive handle; used to extend the socket into hard-to-reach places

_____g. Drive handle designed so it can be used in either direction with very little swinging space

4. Ratchet handle
5. Flex or hinge handle
6. Extension
7. Speed handle

9. Match types of tubing tools to their uses. Write the correct numbers in the blanks.

_____a. Used to enlarge tubing by driving it into the end of tubing so that another tube of the same size may be slipped into it

_____b. Designed to hold tubing in the correct position while it is being flared or swaged

_____c. Designed to cut tubing by advancing blade into the tubing while rotating the cutter at the same time

_____d. Designed to bend or shape tubing without collapsing it, so that the tubing will fit in the position where it is needed

_____e. Designed to create a flare on the end of tubing by forcing a 45° cone into the end of tubing being held in the flaring block

1. Tubing cutter
2. Flaring tool
3. Flaring block
4. Tubing benders
5. Swage punch

10. Match types of cutting and threading tools used on iron pipe to their uses. Write the correct numbers in the blanks.

_____a. Used to remove burrs from inside edge of pipe

_____b. Used for cutting external threads on pipe

_____c. For holding pipe while cutting and threading

_____d. Used to cut iron pipe to a desired length

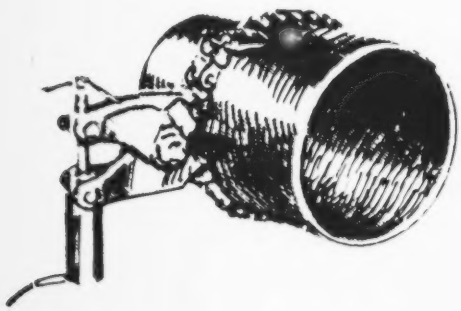
_____e. Used to hold pipe while cutting, threading, reaming and while attaching or removing fittings or sections of pipe

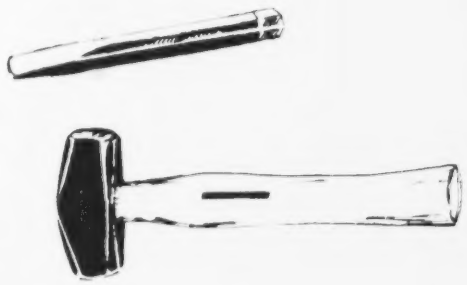
1. Pipe vise
2. Pipe cutter
3. Pipe dies and heads
4. Pipe reamer
5. Vise stand

TEST

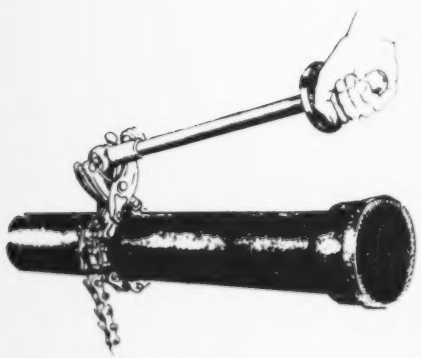
11. Identify the following types of cast iron pipe cutters. Write the correct names in the blanks.

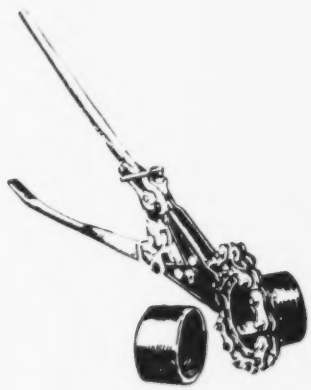
Ratchet cutter
Hammer and chisel
Squeeze-type cutter
Hydraulic cutter





a. _____ b. _____





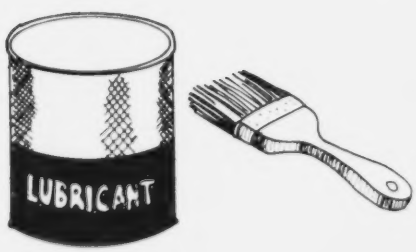
c. _____ d. _____

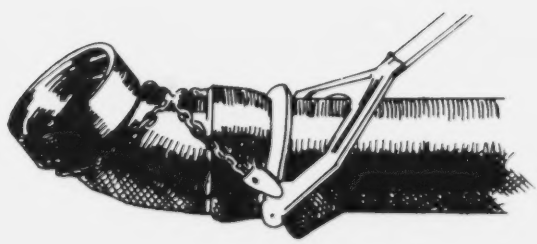
TEST

12. Identify the following types of cast iron pipe assembly tools. Write the correct names in the blanks.

Pipe lubricant and brush **Lead hammer**
Pipe puller

a. _____



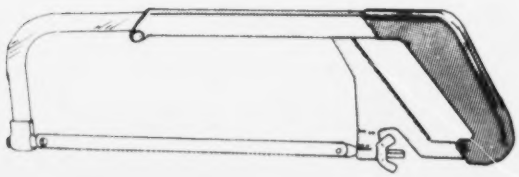


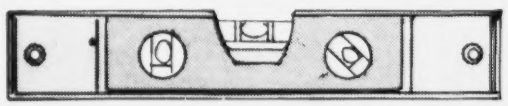
b. _____ c. _____

TEST

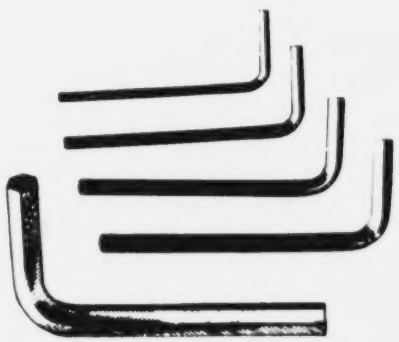
13. Identify the following miscellaneous hand tools. Write the correct names in the blanks.

Hex key wrenches
Basin wrench
Utility level
Tap wrench
Torpedo level
Thread tap
Hack saw

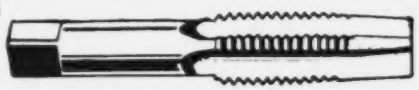




a. _____ b. _____

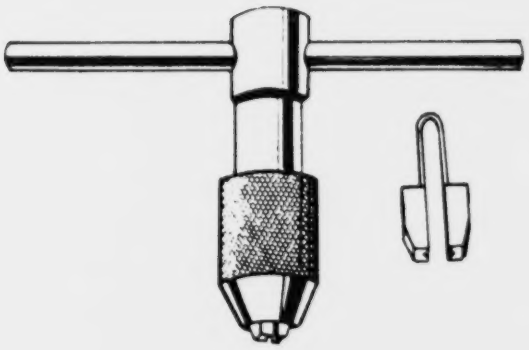


c. _____ d. _____



e. _____ f. _____

TEST



g. _____

14. State six guidelines for proper care and safe use of hand tools.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

e. _____

_____

f. _____

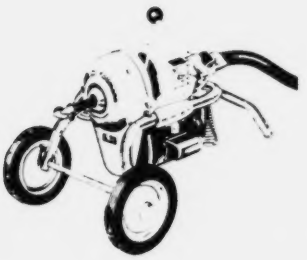
_____

TEST

15. Identify the following types of power tools used by plumbers. Write the correct names in the blanks.

¼" drill	**Angle drill**	**Portable power-driven vise stand**
½" drill	**Jig saw (saber saw)**	**Electric power drain cleaner**
Air hammer	**Rotary hammer**	**Portable band saw**
Bench band saw	**Hammer drill**	**Powder-actuated tool**
Portable power driven threading machine	**Portable circular saw**	**Portable electric pipe threader**
Compressed air or gasoline power drain cleaner	**Reciprocating saw**	**Electric snake**
	Chipping hammer	

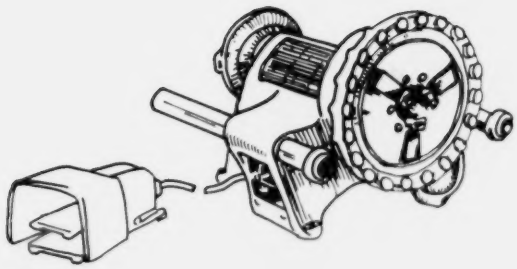
a. _____ b. _____



c. _____ d. _____

TEST

e. _____

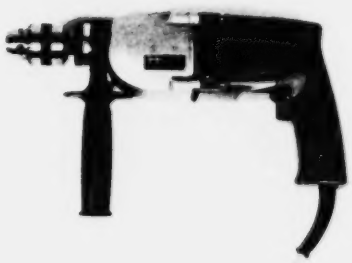


f. _____

g. _____

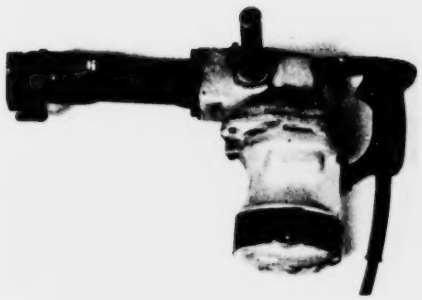
h. _____

i. _____

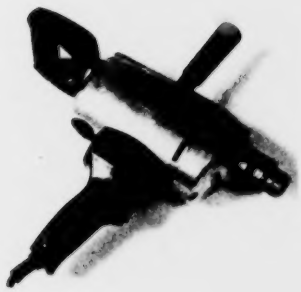


j. _____

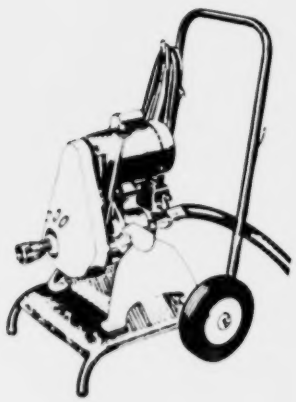
TEST



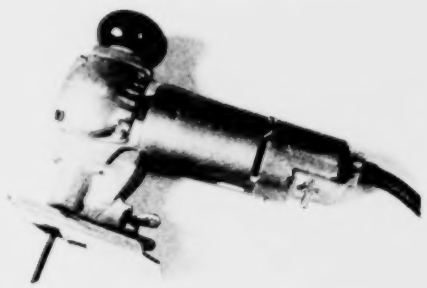
k. _____



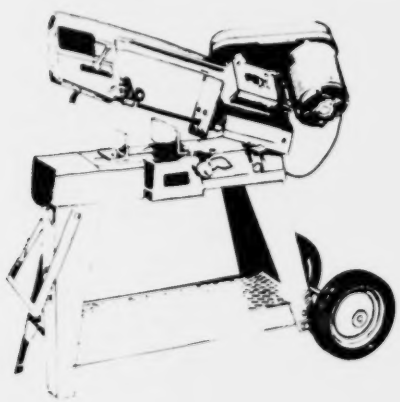
l. _____



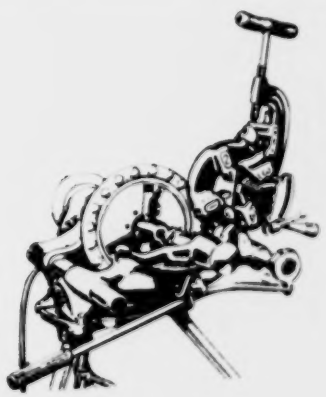
m. _____



n. _____

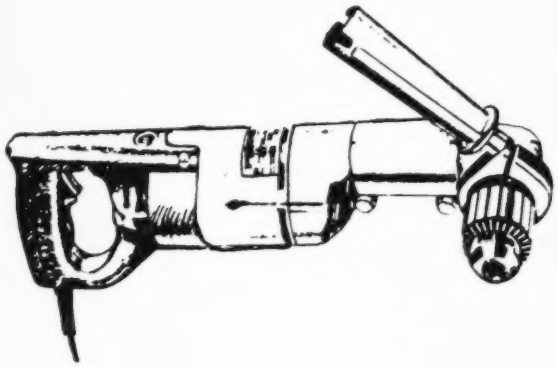


o. _____

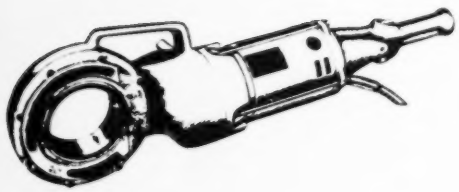


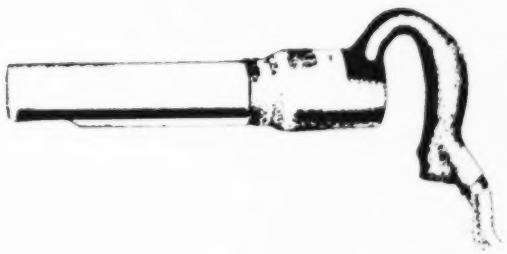
p. _____

TEST



q. _____





r. _____ s. _____

16. State six guidelines for proper care and safe use of power tools.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

e. _____

_____

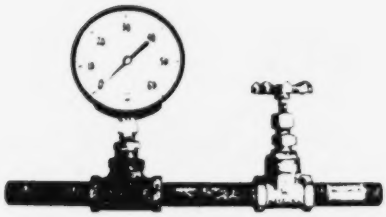
TEST

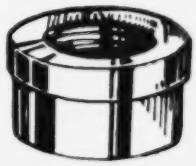
f. _____

_____

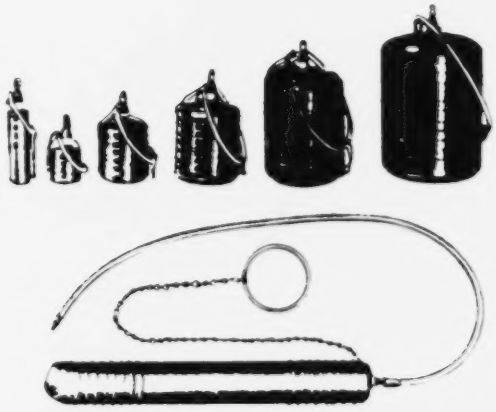
17. Identify the following types of testing equipment. Write the correct names in the blanks.

Mechanical test plug
Test gauge assembly
Test cap for copper or plastic
Inflatable rubber test plugs
Test cap for threaded pipe
Tire pump



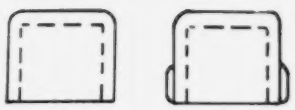


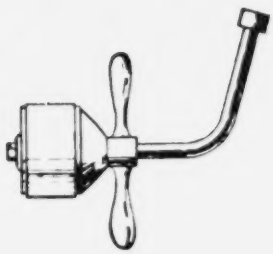
a. _____ b. _____



c. _____ d. _____

TEST





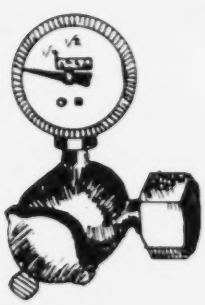
e. _____ f. _____

18. Identify the following types of torches and accessories used by plumbers. Write the correct names in the blanks.

a. Air/acetylene torch

Hose
Fine tip
Regulator
"B" tank
Extra large tip
Striker
Torch handle
Medium tip
Cylinder wrench
"MC" tank
High-temperature wrap-around flame tip

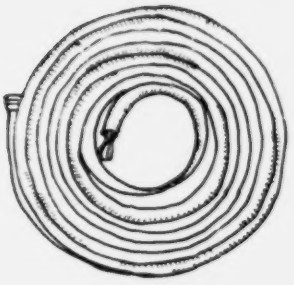
1) _____ 2) _____



4) _____

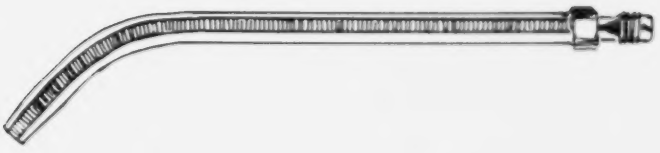
3) _____ 5) _____

TEST



6) _____ 7) _____

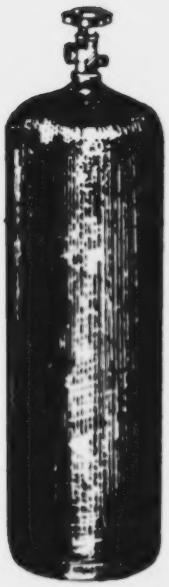
8) _____



9) _____

10) _____

TEST

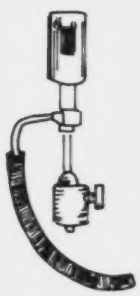


11) _____

b. Air/propane torch

Torch handle
Tank key
Regulator
Large tip
Hose
Striker
Small tip

High-temperature wraparound flame tip
2 1/2 pound liquified petroleum cylinder
20 pound liquified petroleum cylinder
Halide torch leak detector

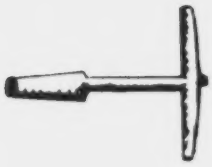


1) _____

2) _____

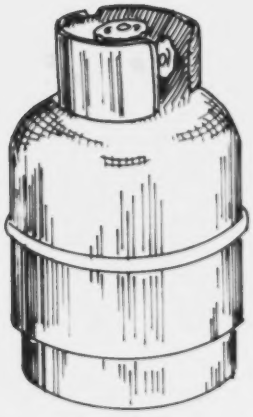
3) _____

TEST

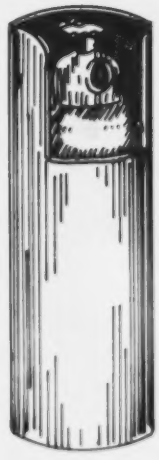


4) _____

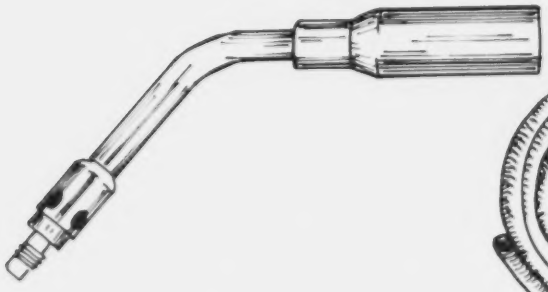
5) _____



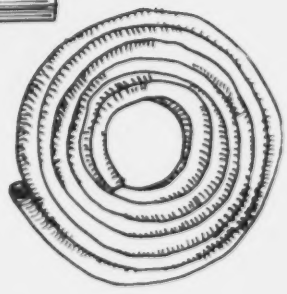
6) _____



7) _____

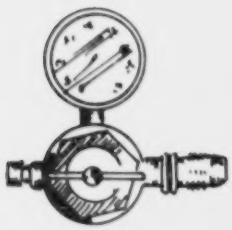


8) _____



9) _____

TEST



10) _____ 11) _____

19. State six guidelines for proper care and safe use of testing equipment and torches.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

e. _____

_____

f. _____

_____

PLUMBING TOOLS
UNIT II

ANSWERS TO TEST

1. a. 8
   b. 3
   c. 12
   d. 10
   e. 1
   f. 5
   g. 11
   h. 4
   i. 2
   j. 6
   k. 9
   l. 7

2. a. Phillips
   b. Offset
   c. Standard
   d. Clutch head

3. a. 3
   b. 1
   c. 4
   d. 2

4. a. 2
   b. 4
   c. 1
   d. 5
   e. 3

5. a. Ball peen
   b. Sledge
   c. Soft face
   d. Claw

6. a. 6
   b. 2
   c. 4
   d. 5
   e. 3
   f. 1

7. a. Triangular
   b. Round
   c. Flat
   d. Half round

8. a. 2
   b. 5
   c. 3
   d. 7
   e. 1
   f. 6
   g. 4

ANSWERS TO TEST

9. a. 5
   b. 3
   c. 1
   d. 4
   e. 2

10. a. 4
    b. 3
    c. 5
    d. 2
    e. 1

11. a. Hydraulic cutter
    b. Hammer and chisel
    c. Ratchet cutter
    d. Squeeze-type cutter

12. a. Lead hammer
    b. Pipe lubricant and brush
    c. Pipe puller

13. a. Hack saw
    b. Torpedo level
    c. Basin wrench
    d. Hex key wrenches
    e. Adjustable level
    f. Thread tap
    g. Tap wrench

14. Answer should include any six of the following guidelines.

    a. Use good quality tools
    b. Use tools only for their intended purpose
    c. *Never* bend or distort a rule
    d. Keep moisture away from steel tapes
    e. Keep cutting edges and points sharp and protected
    f. *Do not* hammer on screwdrivers
    g. Repair or replace worn or damaged tools
    h. Keep all handles tight
    i. *Do not* use pliers in place of wrenches
    j. Have all metal handles insulated when working on or near electrical circuits
    k. *Do not* hammer or pry with files or screwdrivers
    l. *Do not* use an extension pipe or cheater bar on handles of tools
    m. Use oil on threading tools when cutting threads

15. a. Portable band saw
    b. Electric snake

ANSWERS TO TEST

c. Powder-actuated tool
d Electric power drain cleaner
e. 1/4" drill
f. Portable power-driven vise stand
g. Hammer drill
h. Portable circular saw
i. Reciprocating saw
j. Rotary hammer
k. Chipping hammer
l. 1/2" drill
m. Compressed air or gasoline power drain cleaner
n. Jig saw (saber saw)
o. Bench band saw
p. Portable electric pipe threader
q. Angle drill
r. Portable power driven threading machine
s. Air hammer

16. Answer should include any six of the following guidelines.

a. Wear safety goggles
b. Know the tool you are using, its application, limitations, and potential hazards
c. Select proper tool for the job
d. Be sure all tools are grounded before using
e. *Never* remove ground plug from the equipment cord
f. Remove adjusting keys and wrenches before turning on tool
g. Keep work area free of clutter
h. *Never* operate tools with guards removed
i. Be sure saw blades, drills, and cutters are sharp, clean, and regularly maintained
j. Use only accessories recommended by the manufacturer
k. *Do not* force tools
l. *Never* leave tool running unattended

17. a. Test gauge assembly
b. Test cap for threaded pipe
c. Tire pump
d. Inflatable rubber test plugs
e. Test cap for copper or plastic
f. Mechanical test plug

18. a. Air/acetylene torch
1) Striker
2) Fine tip
3) Regulator
4) Cylinder wrench
5) Medium tip

ANSWERS TO TEST

6) "MC" tank
7) Hose
8) Torch handle
9) Extra large tip
10) High-temperature wraparound flame tip
11) "B" tank

b. Air/propane torch
1) Halide torch leak detector
2) Striker
3) Large tip
4) Tank key
5) Torch handle
6) 20 pound liquified petroleum cylinder
7) 2 ½ pound liquified petroleum cylinder
8) High-temperature wraparound flame tip
9) Hose
10) Regulator
11) Small tip

19. Answer should include any six of the following guidelines.

a. Protect glass on gauges from breaking
b. Keep all testing equipment clean and properly maintained
c. *Do not* overinflate test plugs
d. Keep torches and tips clean and handle carefully
e. Use proper wrenches on fuel tanks and torch tips
f. Use proper regulator on the proper cylinder
g. *Do not* force connections of hoses and regulators
h. *Do not* exceed recommended pressures
i. *Do not* attempt to repair faulty regulators
j. Test hoses for leaks prior to using; replace if damaged
k. Keep hose properly rolled and stored when not in use
l. Avoid circumstances where a hose can be rolled over, kinked, burned, or subject to falling objects or hot metals
m. *Never* use oil or grease on torches or other connections
n. Make a final inspection to be sure all connections are tight

PLUMBING LAYOUT
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to develop plan and isometric sketches, and riser diagrams. The student will show this ability by completing the unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with plumbing layout to their definitions.
2. Select from a list information pertaining to plan sketches.
3. Select from a list information pertaining to riser diagrams.
4. Select from a list information pertaining to isometric sketches.
5. Label methods used to measure pipe.
6. Develop three types of sketches of a drainage system in a basement floor.
7. Develop an isometric sketch of a drainage system.

PLUMBING LAYOUT
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Assignment sheets

1. Assignment Sheet #1 — Develop Three Types of Sketches of a Drainage System in a Basement Floor

2. Assignment Sheet #2 — Develop an Isometric Sketch of a Drainage System

E. Answers to assignment sheets

F. Test

G. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Tools and materials necessary to accomplish procedures in assignment sheets

2. Samples of house plans and commercial building plans, samples of other plan sketches, riser diagrams and isometric sketches

C. Introduce unit to students.

- Invite a resource person to class to reinforce information provided in the unit.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

1. Discuss the different drawings used in plumbing layout.

SUGGESTED ACTIVITIES

2. Discuss drafting and drawing techniques.

   - Display samples of the various drafting tools needed to complete assignment sheets, explain and demonstrate the use of each tool.
   - Allow students to handle the different tools so they may become familiar with them, then have students practice using the various tools.

F. Provide students with information and assignment sheets.

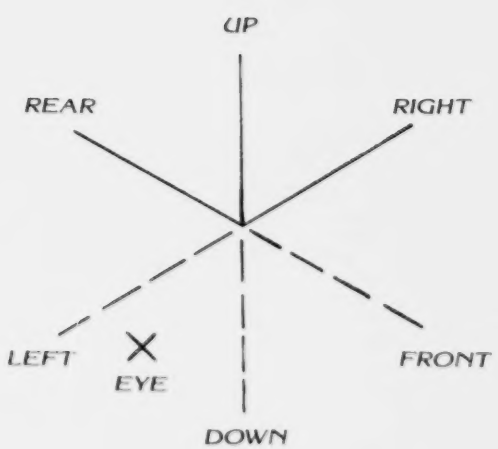
G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with plumbing layout.

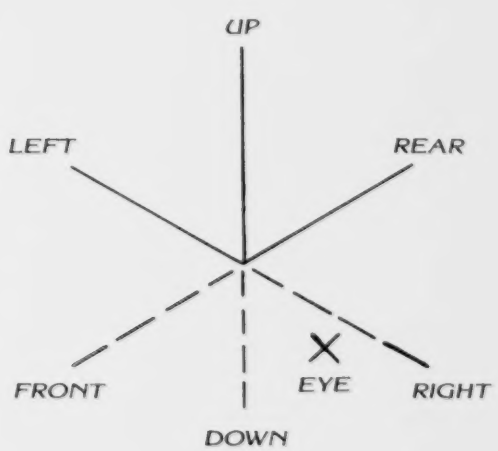
   - Show students examples to illustrate appropriate terms.
   - Explain how knowing definitions to the various terms will help to better understand other objectives and assignment sheets.

2. Use Information Sheet, Sections II through IV, to discuss information pertaining to plan and isometric sketches and riser diagrams.

   - Provide students with examples of the different drawings.
   - Have students trace available isometric sketches to become more familiar with the technique of isometric sketching.
   - Draw the following illustration on the chalkboard. This illustration will show how isometrics can best be understood by visualizing a house from a 30-degree angle with either the left or the right eye.



ISOMETRIC DIRECTIONS
LEFT EYE POSITION



ISOMETRIC DIRECTIONS
RIGHT EYE POSITION

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section V, to discuss methods used to measure pipe.

   - Demonstrate methods used to measure pipe.
   - Allow students to measure various lengths of pipe with and without different types of fittings.

4. Use Information Sheet, Sections VI and VII, to discuss assignment sheets.

   - Discuss and demonstrate the various techniques used to complete assignment sheets.
   - Have students practice these techniques, then have the students complete assignment sheets.

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate sections of the competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to the students as needed.)

III. Unit reference — Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing*. Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.

PLUMBING LAYOUT
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with plumbing layout

A. **Plan view** — Drawing showing piping system as viewed from directly above

B. **Elevation view** -- Vertical, two-dimensional view of the exterior face of a building, showing general shape and design of exterior and roof

C. **Isometric sketch** — Three-dimensional drawing used by plumbers to get the "real" picture

D. **Scale drawing** — Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

E. **Riser diagram** — Elevation view of the piping system

F. **Pitch** — Amount of slope or fall of horizontal run of pipe required by plumbing code

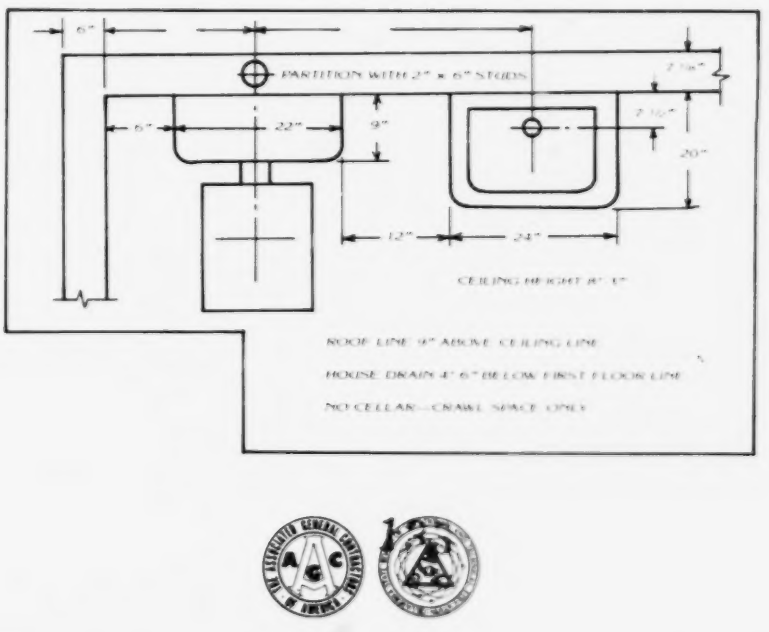
G. **Plumbing code** — Set of state or local rules governing the quality of plumbing installations

II. Information pertaining to plan sketches (Figures 1 and 2)

A. Plan views show system as viewed from directly above

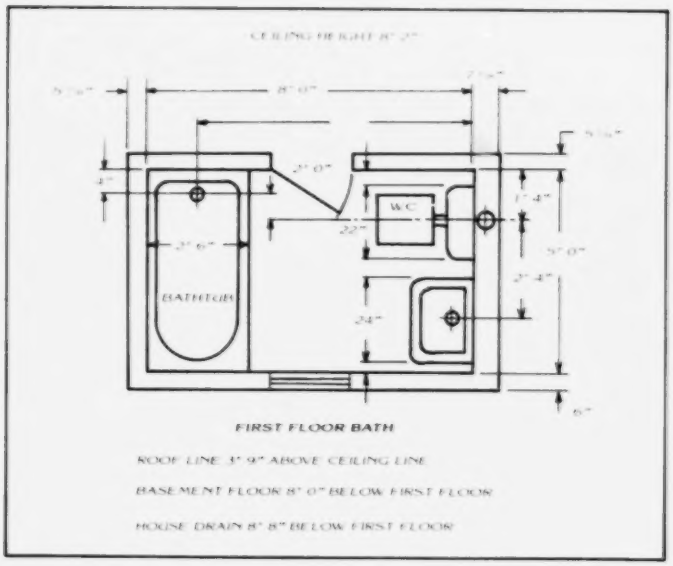
EXAMPLES:

FIGURE 1



INFORMATION SHEET

FIGURE 2


W.C.
BATHTUB
FIRST FLOOR BATH
ROOF LINE 3' 9" ABOVE CEILING LINE
BASEMENT FLOOR 8' 0" BELOW FIRST FLOOR
HOUSE DRAIN 8' 8" BELOW FIRST FLOOR

B. Plan view does not show pitch of pipe

C. Plan view can be used to determine

1. Length of pipe
2. Location and types of fittings
3. Location of floor drains
4. Location of cleanouts
5. Direction of flow
6. Labor estimates

D. Plan view can serve as a record after the floor has been installed

E. Plan view should show all floor drainage including storm drainage and foundation drainage

III. Information pertaining to riser diagrams (Figures 3-6)

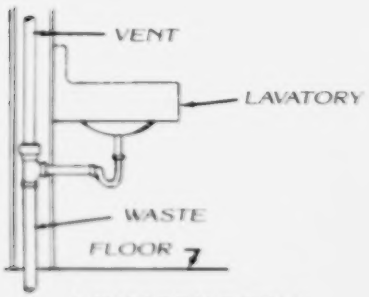
A. Riser diagrams are schematics of sectional views through a building showing the piping system or parts of a system

INFORMATION SHEET

B. Riser diagrams are not true pictures due to sketch being two dimensional

EXAMPLES:

FIGURE 3



LAVATORY DETAIL

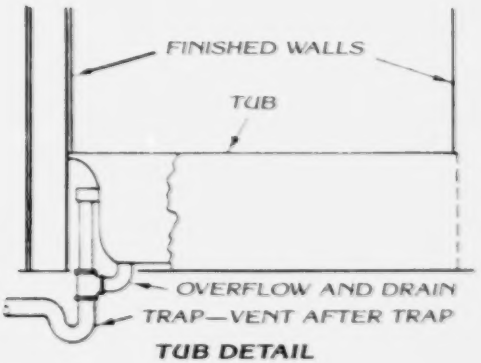
FIGURE 4

SCHEMATIC

C. Riser diagrams are valuable in determining code and inspection requirements

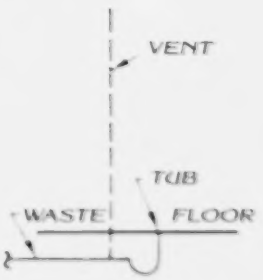
EXAMPLES:

FIGURE 5



TUB DETAIL

FIGURE 6



SCHEMATIC

IV. Information pertaining to isometric sketches (Figures 7-12)

A. Isometric sketches are used to show a three-dimensional picture in one drawing

B. Isometrics combine the plan and elevation views into one drawing

INFORMATION SHEET

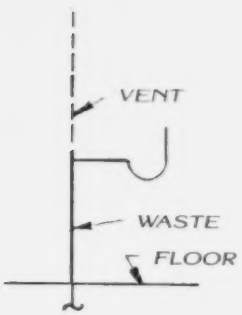
C. Scale drawings of isometric views help to determine an accurate materials list

D. Pipes that are vertical on a plan or elevation view, such as soil, water, and vent stacks, remain vertical in the isometric drawing

E. Pipes that are horizontal on a plan or elevation view are shown at a 30-degree angle in the isometric drawing

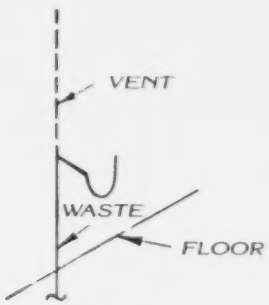
EXAMPLES:

FIGURE 7



SCHEMATIC

FIGURE 8



ISOMETRIC

(NOTE: Figures 9 and 10 show a house in outline form. The horizontal drainage system is shown at 30 degrees; vertical lines at 90 degrees.)

EXAMPLES:

FIGURE 9

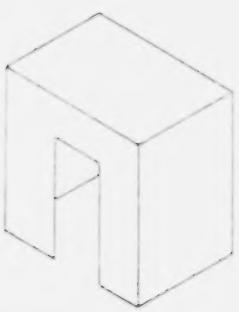
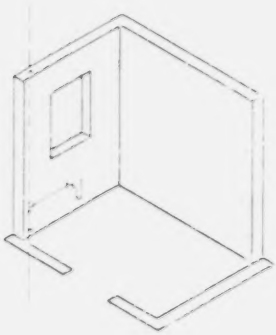


FIGURE 10

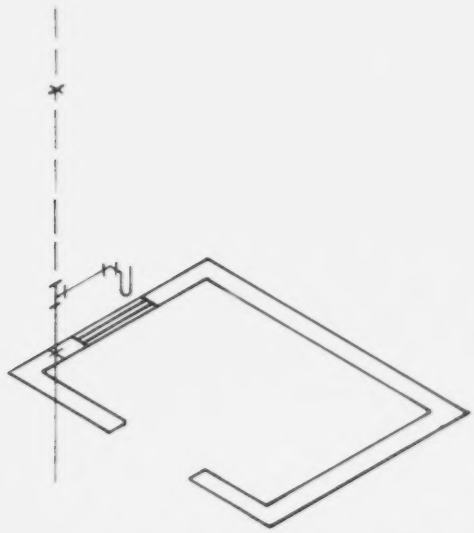


INFORMATION SHEET

(NOTE: Figure 11 shows the same system without the house lines.)

EXAMPLE:

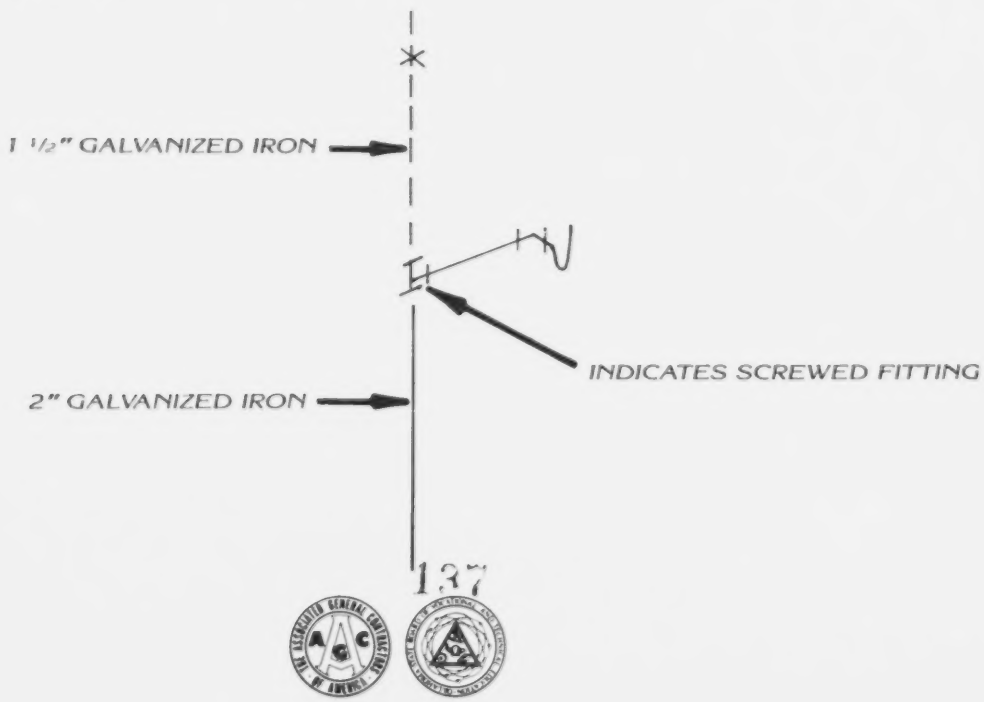
FIGURE 11



F. Careful consideration to detail can indicate type of fitting and direction of flow

EXAMPLE:

FIGURE 12

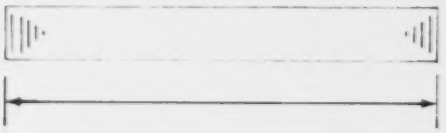


INFORMATION SHEET

V. Methods used to measure pipe (Figures 13-15)

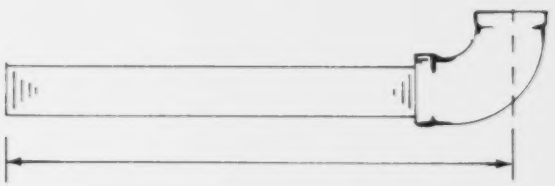
A. End to end — Measure pipe from end to end without fittings

FIGURE 13



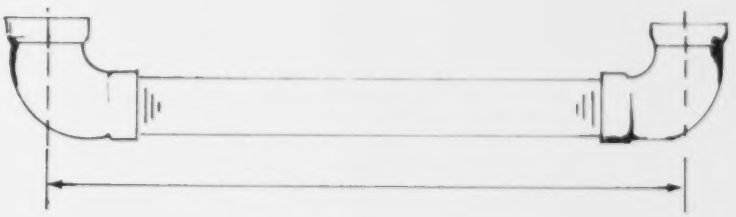
B. End to center — Measure from end of pipe to center of fitting

FIGURE 14



C. Center to center — Measure from center of one fitting to center of the other fitting

FIGURE 15



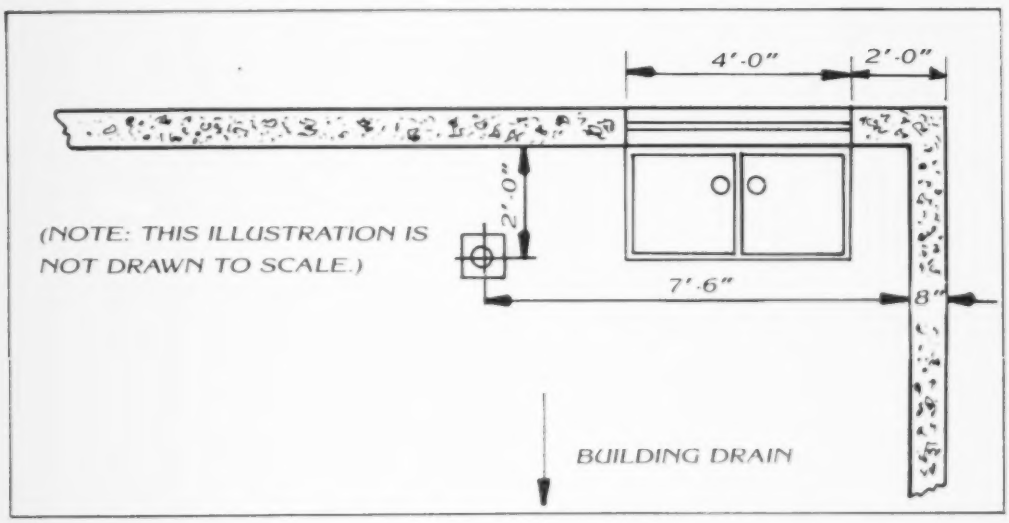
PLUMBING LAYOUT
UNIT III

ASSIGNMENT SHEET #1 — DEVELOP THREE TYPES OF SKETCHES OF A DRAINAGE SYSTEM IN A BASEMENT FLOOR

NAME _____ SCORE _____

A competent plumber must be able to develop sketches and diagrams to facilitate installations and to serve as a record after floor placement.

In the spaces provided, draw plan and isometric sketches and a riser diagram of the basement drainage system illustrated below.



A. Plan sketch — Show scale, building walls, window openings, and all piping.

PLUMBING LAYOUT
UNIT III

ASSIGNMENT SHEET #2 — DEVELOP AN ISOMETRIC SKETCH OF A DRAINAGE SYSTEM

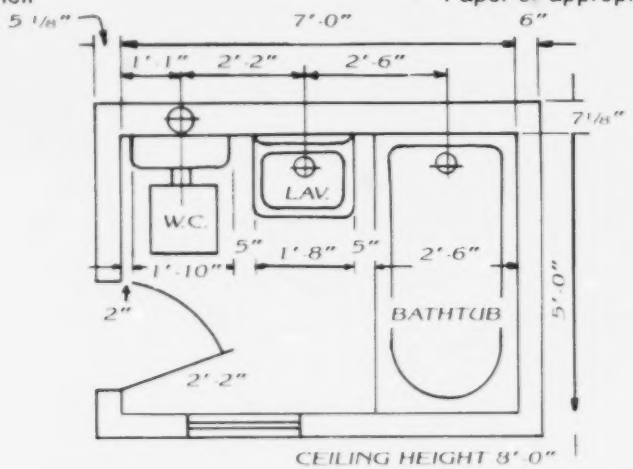
NAME _____ SCORE _____

Plumbers use isometric sketches to show three-dimensional views in single drawings. Isometric sketches drawn to scale help the plumber to determine an accurate materials list for a job.

Draw an isometric sketch of the piping system in the following plan. The scale to be used is 1/8" = 1'.

You will need:

- Drawing board or large desk
- Triangle—45° (8" sides)
- Triangle—30° x 60° (10" on long side)
- 2-H pencil
- Eraser
- Pencil sharpener
- Architect's scale
- Paper or appropriate material



(NOTE: CONNECT WASTE FOR TUB AND LAVATORY TO A SEPARATE SANITARY TEE JUST BELOW THE W.C.)

A. Note the scale to be used.

B. Draw drainage layout on the plan.

C. Draw an isometric view to scale. Show inside or outside wall.

D. Draw isometric view of all drainage piping.

E. Size all piping according to local code or instructor's instructions.

ASSIGNMENT SHEET #1

B. Riser diagram

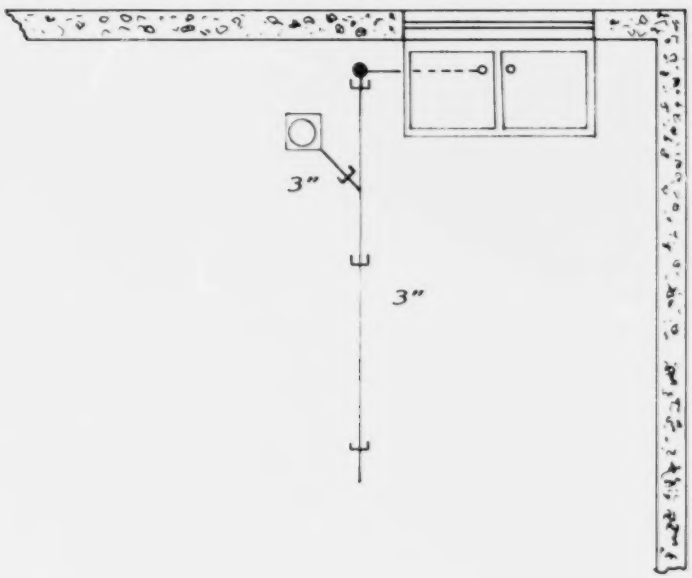
C. Isometric sketch

PLUMBING LAYOUT
UNIT III

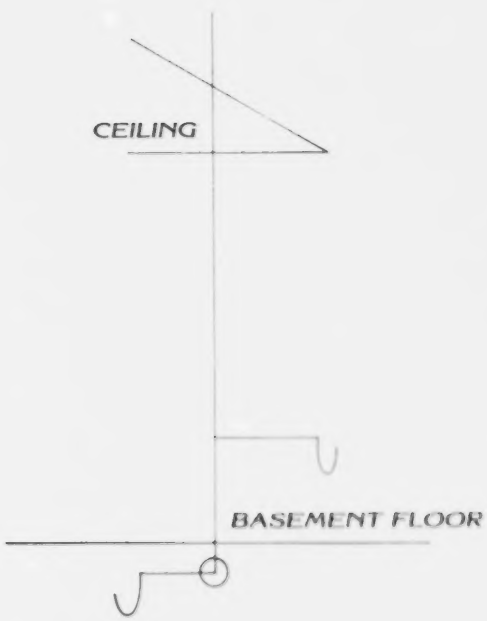
ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A.

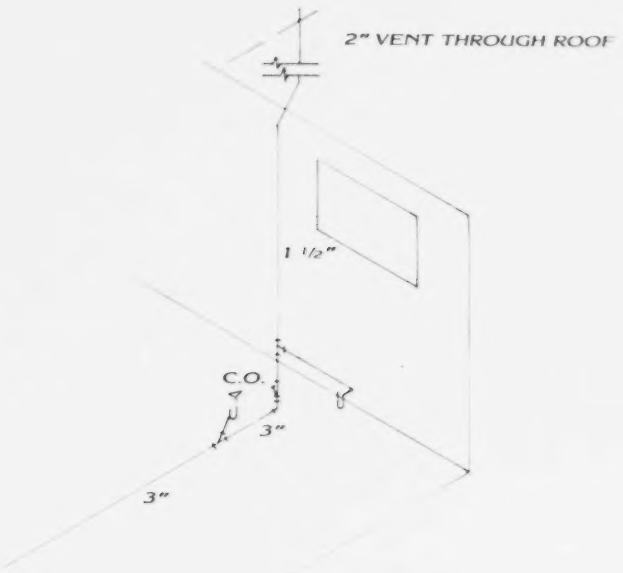


B.

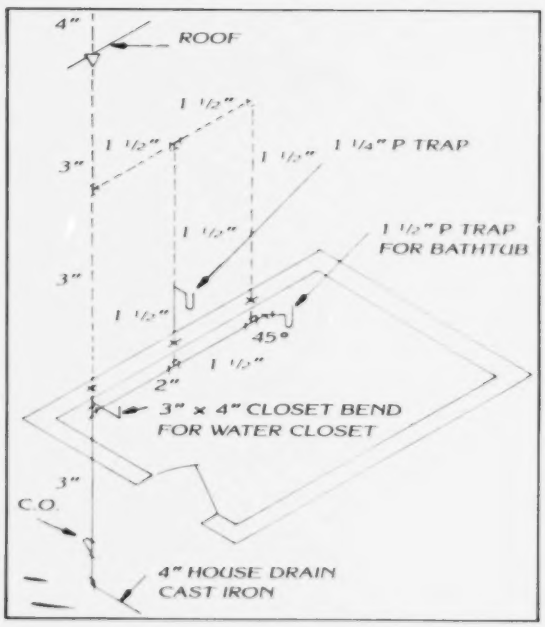


ANSWERS TO ASSIGNMENT SHEETS

C.



Assignment Sheet #2



PLUMBING LAYOUT
UNIT III

TEST

NAME _____ SCORE _____

1. Match terms associated with plumbing layout to their correct definitions. Write the correct numbers in the blanks.

_____a. Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

_____b. Drawing showing piping system as viewed from directly above

_____c. Set of state or local rules governing the quality of plumbing installations

_____d. Vertical, two-dimensional view of the exterior face of a building, showing general shape and design of exterior and roof

_____e. Three-dimensional drawing used by plumbers to get the "real" picture

_____f. Elevation view of the piping system

_____g. Amount of slope or fall of horizontal run of pipe required by plumbing code

1. Plumbing code
2. Isometric sketch
3. Plan view
4. Pitch
5. Elevation view
6. Scale drawing
7. Riser diagram

2. Select from the following list information pertaining to plan sketches. Write an "X" in the blank before each correct answer.

_____a. Plan view shows sketch as viewed from the side

_____b. Plan view does not show pitch of pipe

_____c. Plan view can be used to determine length of pipe

_____d. Plan view can be used to determine direction of flow

_____e. Plan view can be used to determine labor estimates

_____f. Plan view can be used to determine height of sink

_____g. Plan view cannot serve as a record after the floor has been installed

_____h. Plan view should show all floor drainage including storm drainage and foundation drainage

TEST

3. Select from the following list information pertaining to riser diagrams. Write an "X" in the blank before each correct answer.

   _____a. Riser diagrams are valuable in determining code and inspection requirements

   _____b. Riser diagrams are true pictures since they are three dimensional

   _____c. Riser diagrams are schematics of sectional views through a building showing the piping system or parts of a system

4. Select from the following list information pertaining to isometric sketches. Write an "X" in the blank before each correct answer.

   _____a. Isometric sketches are used to show a three-dimensional picture in one drawing

   _____b. Isometrics combine the take-off view and elevation view into one drawing

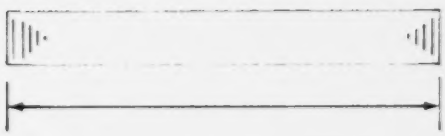
   _____c. Scale drawings of isometric views help to determine an accurate materials list

   _____d. Pipes that are vertical on a plan or elevation view, such as soil, water, and vent stacks, are vertical in the isometric drawing

   _____e. Pipes that are diagonal on a plan or elevation view are shown at a 30-degree angle in the isometric drawing

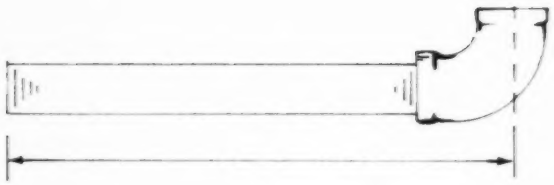
5. Label the following methods used to measure pipe.

a. _____



b. _____

TEST



c. _____

(NOTE: Test items six and seven list the assignment sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Develop three types of sketches of a drainage system in a basement floor.

7. Develop an isometric sketch of a drainage system.

PLUMBING LAYOUT
UNIT III

ANSWERS TO TEST

1. a. 6
   b. 3
   c. 1
   d. 5
   e. 2
   f. 7
   g. 4

2. b, c, d, e, h

3. a, c

4. a, c, d

5. a. Center to center
   b. End to end
   c. End to center

6. Evaluated to the satisfaction of the instructor.

7. Evaluated to the satisfaction of the instructor.

PLUMBING BASIC SKILLS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to select tools, materials, and equipment to join pipe. The student should also be able to perform the different skills necessary to join various types of pipes. The student will show this ability by completing the job sheets and unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with plumbing basic skills to their definitions.
2. State basic skills necessary to perform plumbing jobs.
3. Select tools, materials, and equipment necessary to join steel pipe.
4. Select tools, materials, and equipment necessary to join copper tubing by the sweat, compression, and flare methods.
5. Select tools, materials, and equipment necessary to join PVC and flexible plastic pipe.
6. Select tools, materials, and equipment necessary to join no-hub type cast iron pipe.
7. Demonstrate the ability to
   a. Measure and mark a predetermined length of pipe.
   b. Use a pipe cutter to cut a length of steel pipe.
   c. Use a hacksaw to cut a length of steel pipe.
   d. Use a pipe reamer to remove burrs from steel pipe.
   e. Cut threads on a piece of steel pipe.
   f. Cut, ream, thread, and join a piece of one-inch galvanized steel pipe.
   g. Cut, ream, and join copper tubing using the sweat method.
   h. Bend copper tubing with a spring bender.
   i. Cut, ream, flare, and join copper tubing using the flare method.
   j. Cut, ream, and join copper tubing using the compression method.
   k. Cut, ream, and join plastic pipe.
   l. Join cast iron pipe to a cast iron fitting using a no-hub joint.

PLUMBING BASIC SKILLS
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1 — Measure and Mark a Predetermined Length of Pipe
2. Job Sheet #2 — Use a Pipe Cutter to Cut a Length of Steel Pipe
3. Job Sheet #3 — Use a Hacksaw to Cut a Length of Steel Pipe
4. Job Sheet #4 — Use a Pipe Reamer to Remove Burrs from Steel Pipe
5. Job Sheet #5 — Cut Threads on a Piece of Steel Pipe
6. Job Sheet #6 — Cut, Ream, Thread, and Join a Piece of One-Inch Galvanized Steel Pipe
7. Job Sheet #7 — Cut, Ream, and Join Copper Tubing Using the Sweat Method
8. Job Sheet #8 — Bend Copper Tubing with a Spring Bender
9. Job Sheet #9 — Cut, Ream, Flare, and Join Copper Tubing Using the Flare Method
10. Job Sheet #10 — Cut, Ream, and Join Copper Tubing Using the Compression Method
11. Job Sheet #11 — Cut, Ream, and Join Plastic Pipe
12. Job Sheet #12 — Join Cast Iron Pipe to a Cast Iron Fitting Using a No-Hub Joint

E. Test

F. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials needed to accomplish procedures in job sheets.

SUGGESTED ACTIVITIES

C. Provide students with objective sheet.

D. Discuss unit and specific objectives, emphasizing the importance of following safety procedures when working with the various tools and materials.

E. Provide students with information and job sheets.

F. Discuss information and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with plumbing basic skills.

   - Show students examples to illustrate appropriate terms.
   - Explain how knowing definitions for the various terms will help them to better understand the other objectives and the job sheets.

2. Use Information Sheet, Section II, to discuss basic skills necessary to perform plumbing jobs.

   - Demonstrate the various basic skills involved in installing water, heat, and waste pipes.
   - Encourage students to practice the basic skills.
   - Demonstrate procedures in the job sheets.
   - Have students demonstrate the procedures in the job sheets.
   - Have students complete Job Sheet #1 through Job Sheet #12.

3. Use Information Sheet, Sections III through VI, to discuss tools, materials, and equipment necessary to join the various types of pipes and pipe fittings used in plumbing.

   - Display types of tools, materials, and equipment, have students identify the tools, what they are used for an which materials they will be used with.
   - Allow students to handle the various tools, materials, and equipment.
   - Discuss the differences in the types of pipes used, where they are used, and why some are used in one place while other types are used in other places.
   - Discuss water and gas supply lines and which types of pipes are used for each of the supply lines.
   - Discuss soil, waste, and drain lines and which types of pipes are used for each of these lines.

SUGGESTED ACTIVITIES

G. Give test.

H. Critique test and discuss in class.

I. Reteach and retest as necessary.

J. Complete appropriate sections of the competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

III. Unit reference — Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing*. Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.

PLUMBING BASIC SKILLS
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with plumbing basic skills

A. **Sweating** — Method of joining copper tubing using flux and solder applied with heat

B. **Threading** — Cutting spiral grooves on the end of pipe to facilitate joining with a fitting

C. **Cementing** — Method of using a solvent to join PVC pipe

D. **Insert joining** — Method of joining flexible plastic pipe

E. **Reaming** — Removing burrs from inside edge of pipe

F. **No-hub** — Type of cast iron pipe to be joined by special fittings

G. **Neoprene gasket** — Insert in cast iron hub which makes up part of a watertight compression joint

H. **Hub** — Expanded end of cast iron pipe which receives the end of pipe or fitting

(NOTE: The hub is sometimes referred to as the *bell*.)

I. **Spigot end** — End of fitting or pipe which is inserted into hub

J. **Pipe compound (dope)** — Substance applied to pipe threads to help seal the joint

K. **Teflon tape** — Tape used as a joint sealant in place of pipe compound

II. Basic skills necessary to perform plumbing jobs

A. Measure and mark pipe accurately

B. Use a pipe cutter and a hacksaw to cut off steel pipe

C. Use a pipe reamer to remove burrs on steel pipe

D. Use a pipe die to cut threads on steel pipe

E. Use a tubing cutter to cut off copper tubing

F. Use a reamer to remove burrs on copper tubing

G. Use a flaring tool and block to flare end of copper tubing

INFORMATION SHEET

H. Use a hammer-type flaring tool and swaging tool to flare end of copper tubing

I. Use a torch and accessories to sweat joints on copper tubing

J. Join copper tubing using compression method

K. Use a pipe cutter and a handsaw to cut plastic pipe

L. Use a reamer and a knife to remove burrs on plastic pipe

M. Join PVC plastic pipe

N. Join flexible plastic pipe

O. Join no-hub cast iron pipe

P. Join hub-type cast iron pipe

III. Tools, materials, and equipment necessary to join steel pipe

A. Pipe vise

B. Pipe cutter

C. Reamer

D. Pipe dies, head, and stock

E. Pipe wrench

F. Steel pipe

G. Pipe fitting

H. Cutting oil

I. Pipe compound or teflon tape

IV. Tools, materials, and equipment necessary to join copper tubing

A. Sweat joint method

1. Tubing cutter with reamer

2. Sand cloth, emery cloth, or steel wool

3. Type B gas tank with wrench

4. Torch handle and accessories (regulator, hose, tip and striker)

INFORMATION SHEET

5. Copper tubing
6. Sweat fitting
7. Wire solder
8. Flux with brush
9. Wiping cloth
10. Fire extinguisher

B. Compression method

1. Tubing cutter with reamer
2. Adjustable wrench
3. Open-end wrench or flare-nut wrench
4. Copper tubing
5. Compression fitting with ferrule and nut

C. Flare method

1. Tubing cutter with reamer
2. Adjustable wrench
3. Flaring tool and block
4. Open-end or flare-nut wrench
5. Hammer-type flaring tool
6. Swaging tool
7. Small ball peen hammer
8. Copper tubing
9. Flare fitting

V. Tools, materials, and equipment necessary to join plastic pipe

A. PVC pipe

1. PVC pipe cutter or handsaw with mitre box
2. Reamer or knife

INFORMATION SHEET

3. PVC pipe
4. Fitting
5. Cleaning solvent with brush
6. Solvent cement with brush
7. Wiping cloth

B. Flexible plastic pipe

1. Pipe cutter or handsaw
2. Reamer or knife
3. Screwdriver
4. Socket wrench
5. Flexible plastic pipe
6. Fitting
7. Clamps

VI. Tools, materials, and equipment necessary to join no-hub type cast iron pipe

A. Approved torque socket wrench

B. Cast iron pipe

C. Fitting

D. Neoprene gasket

E. Stainless steel shield and clamp assemblies

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #1 — MEASURE AND MARK
A PREDETERMINED LENGTH OF PIPE

I. Tools and materials

A. Folding rule

B. Pencil

C. Piece of ½" pipe

II. Procedure

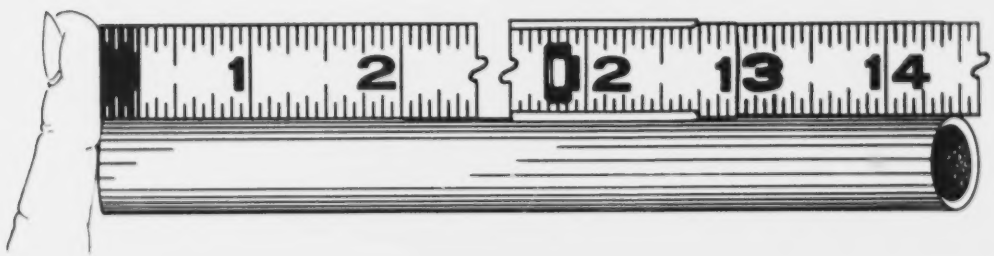
A. Place pipe in suitable position for measuring and marking

B. Determine correct measurement to be made

C. Unfold rule and lay on top of pipe

D. Place finger over end of pipe and butt rule against finger (Figure 1)

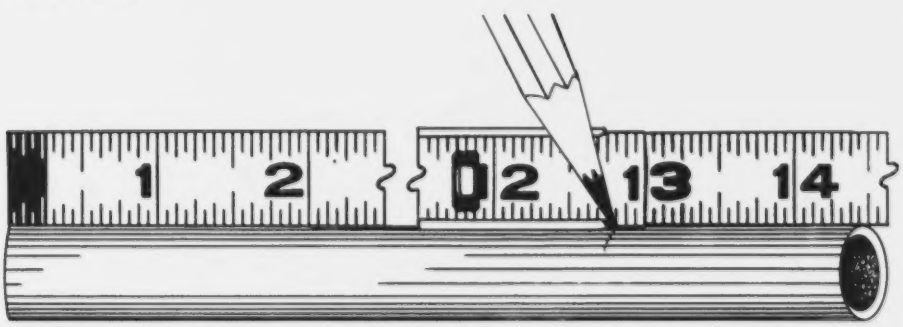
FIGURE 1



E. Hold rule firmly on pipe and read predetermined measurement on rule

F. Mark pipe at point of predetermined measurement (Figure 2)

FIGURE 2



JOB SHEET #1

G. Have instructor check your work

H. Clean up work area and put away tools and materials

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #2 — USE A PIPE CUTTER TO
CUT A LENGTH OF STEEL PIPE

I. Tools and materials

A. Pipe vise

B. Pipe cutter

C. Folding rule

D. Pencil

E. Piece of steel pipe

F. Shop towel

G. Safety glasses

II. Procedure

A. Put on safety glasses

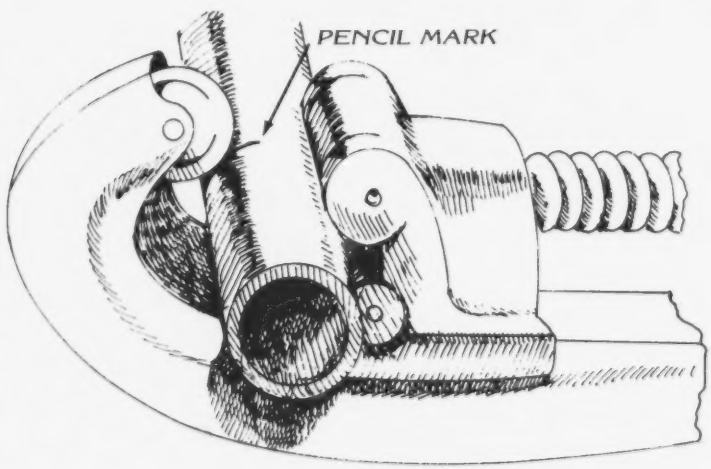
B. Secure piece of steel pipe in vise

C. Measure and mark location of cut with pencil

D. Unscrew pipe cutter until jaw will fit over pipe

E. Locate cutter wheel on the pencil mark (Figure 3)

FIGURE 3

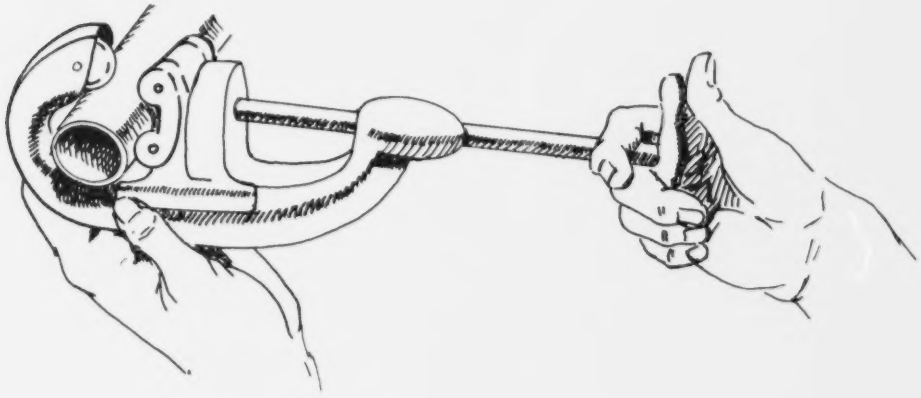


JOB SHEET #2

F. Snug cutter up to the pipe by rotating screw handle (Figure 4)

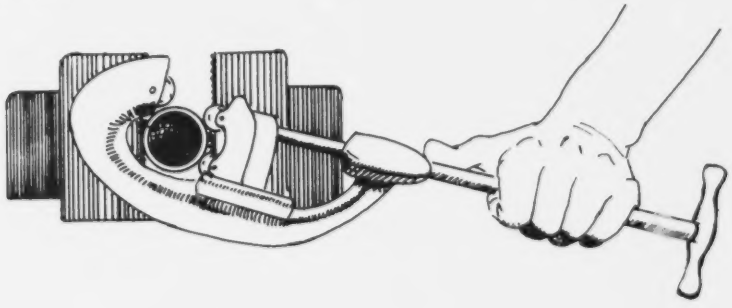
(NOTE: Do not overtighten as this can break the cutter wheel.)

FIGURE 4



G. Rotate cutter counterclockwise to start groove (Figure 5)

FIGURE 5



H. Tighten cutter handle 1/4 turn for each full revolution around the pipe

(NOTE: Overtightening can cause cutters to break.)

I. Continue process until pipe is cut through

CAUTION

When cutting short pieces of pipe, be careful not to cut your arm while rotating the cutter around the pipe.

JOB SHEET #2

J. Clean pipe and cutter with shop towel

K. Have instructor inspect work

L. Clean up work area and put away tools and equipment

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #3 — USE A HACKSAW TO CUT
A LENGTH OF STEEL PIPE

I. Tools and equipment

A. Pipe vise

B. Hacksaw frame with blade

(NOTE: For cutting pipe, a blade with 24 or 32 teeth per inch is recommended.)

C. Piece of steel pipe

D. Safety glasses

E. Pipe reamer

II. Procedure

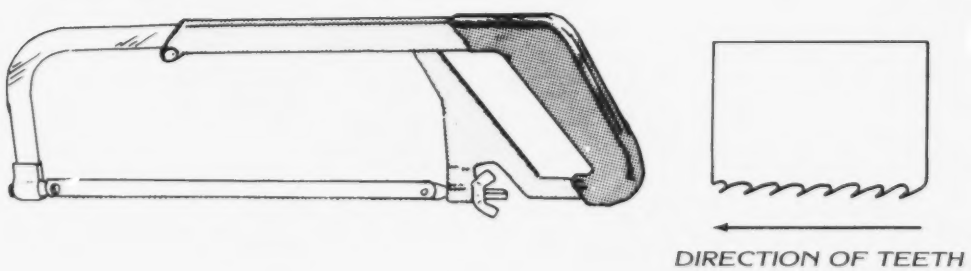
A. Put on safety glasses

B. Secure piece of steel pipe in vise

C. Check hacksaw to make sure that blade is tight, and that teeth are sharp and facing in the right direction (Figure 6)

(NOTE: When selecting saw blades, keep in mind the three-tooth rule—at least three teeth in contact with work.)

FIGURE 6



D. Place saw blade on mark where pipe is to be cut

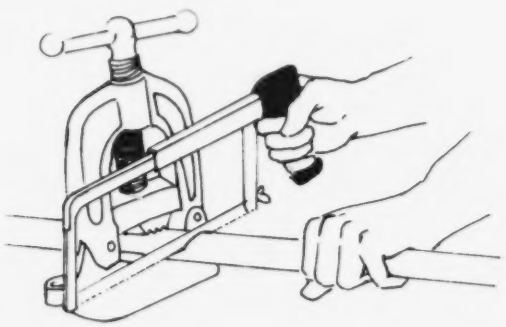
E. Hold saw firmly by the handle and front of frame

JOB SHEET #3

F. Cut with a forward and back movement making about thirty to forty strokes per minute (Figure 7)

(NOTE: Cut on forward stroke only, and use the entire length of blade.)

FIGURE 7



CAUTION

When the saw is about to cut through the stock, ease up on the pressure. Otherwise, you may push your hand into the sharp edge of the pipe still held in the vise.

G. Have instructor check your cut (Figure 8)

(NOTE: Your cut should be straight and relatively smooth.)

FIGURE 8

H. Deburr cut end of both pieces of pipe

I. Clean up area and put away tools and equipment

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #4 — USE A PIPE REAMER TO REMOVE BURRS FROM STEEL PIPE

I. Tools and equipment

A. Pipe vise

B. Reamer with ratchet handle

C. Piece of steel pipe

D. Safety glasses

II. Procedure

CAUTION

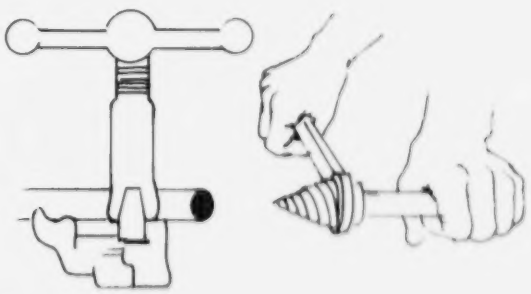
Be safety conscious around cut pieces of steel pipe. Sharp ridges, spurs, and burrs can cause deep cuts.

A. Put on safety glasses

B. Secure piece of steel pipe in vise

C. Insert reamer tip in pipe (Figure 9)

FIGURE 9

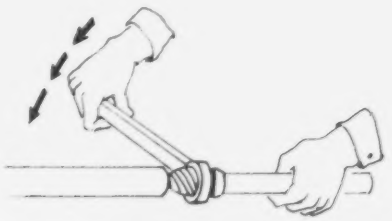


JOB SHEET #4

D. Apply light pressure against reamer while rotating ratchet handle (Figure 10)

(NOTE: If proper pressure is applied to reamer it will bite into pipe instantly.)

FIGURE 10

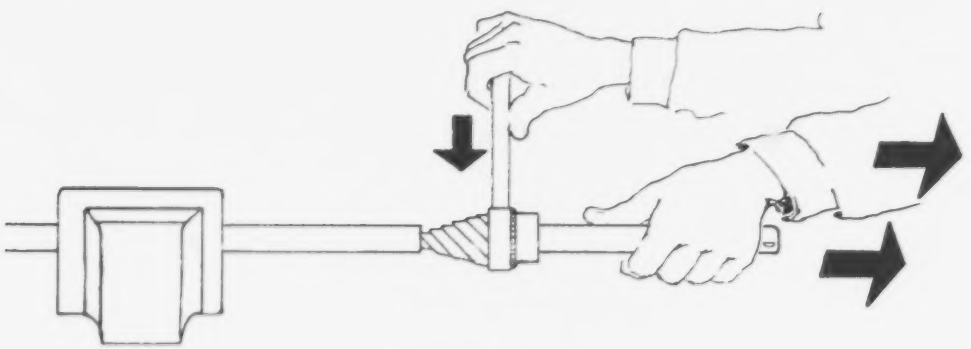


E. Continue to rotate reamer until burrs are removed

F. Pull reamer back while continuing to rotate (Figure 11)

(NOTE: This will prevent reamer from leaving a burr.)

FIGURE 11



G. Have instructor check your work

H. Clean up area and put away tools

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #5 — CUT THREADS ON A PIECE OF STEEL PIPE

I. Tools and equipment

A. Pipe vise

B. Ratchet-type die and die stock

C. Wire brush

D. Piece of steel pipe

E. Cutting oil in oil can

F. Metal drip pan

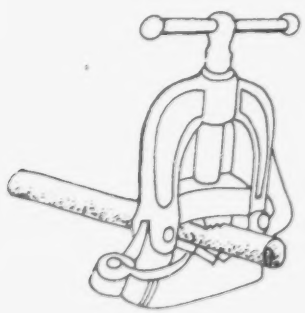
G. Safety glasses

II. Procedure

A. Put on safety glasses

B. Secure piece of steel pipe in vise (Figure 12)

FIGURE 12



C. Place drip pan under vise and end of pipe

(NOTE: Metal drip pan is used to catch dripping oil and steel cuttings.)

D. Apply cutting oil to end of pipe

JOB SHEET #5

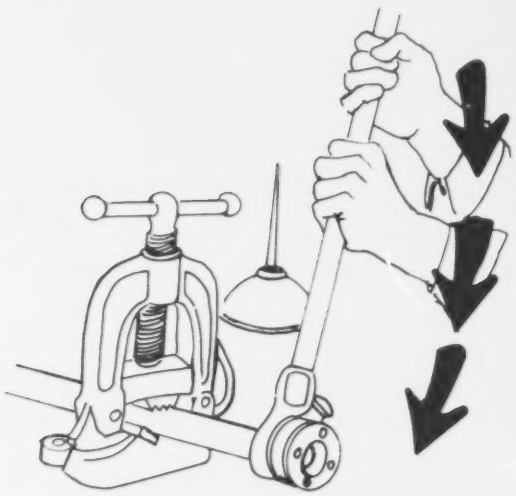
E. Secure pipe die in die stock and position ratchet

F. Place die on end of pipe

G. Apply slight pressure to back of die while starting die (Figure 13)

(NOTE: Be sure die is started straight on the pipe.)

FIGURE 13



H. Apply plenty of cutting oil to pipe while cutting the threads

I. Continue turning pipe die and cutting threads until the desired amount of threads have been cut

J. Reverse ratchet by turning lock 180° and remove die by turning clockwise

(NOTE: Hold onto the die stock firmly while removing it so it won't be dropped when it comes to the end of the threads.)

K. Clean threads with brush

CAUTION

Do not use compressed air for cleaning.

L. Have instructor check your work

M. Clean up area and put away tools and equipment

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #6 — CUT, REAM, THREAD, AND JOIN A PIECE OF ONE-INCH GALVANIZED STEEL PIPE

I. Tools and materials

A. Die

B. Die stock

C. Pipe vise

D. Wire brush

E. Oil can (cutting oil)

F. Piece of one-inch galvanized steel pipe

G. Pencil

H. Shop towel

I. Safety glasses

J. Pipe cutter

K. Reamer

L. Folding rule

M. Drip pan

N. Pipe fitting

II. Procedure

A. Put on safety glasses

B. Secure pipe in vise

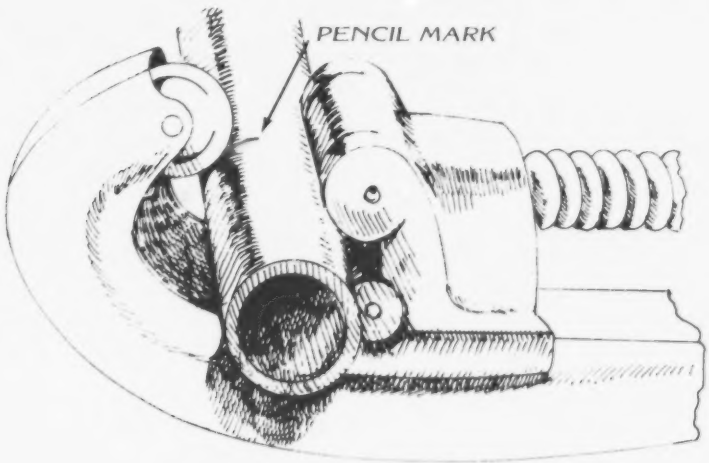
C. Measure and mark pipe at desired length

D. Open pipe cutter until it will fit over pipe

JOB SHEET #6

E. Locate cutter wheel on the pencil mark (Figure 14)

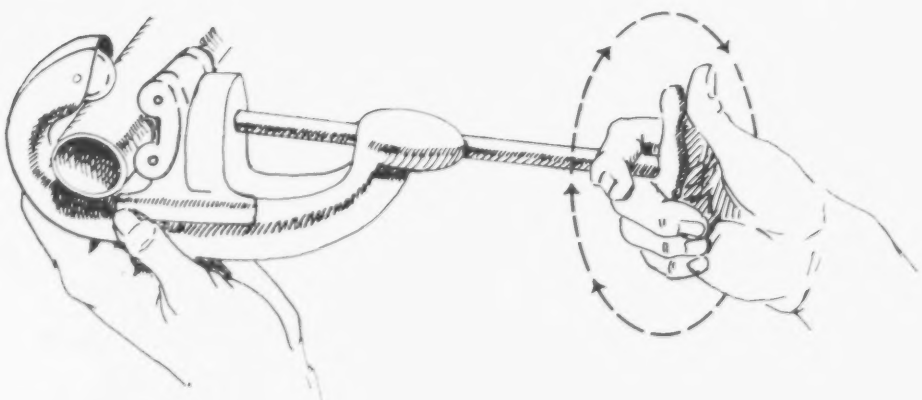
FIGURE 14



F. Snug cutter up to pipe by rotating screw handle (Figure 15)

(NOTE: Do not overtighten as this can break cutter wheel.)

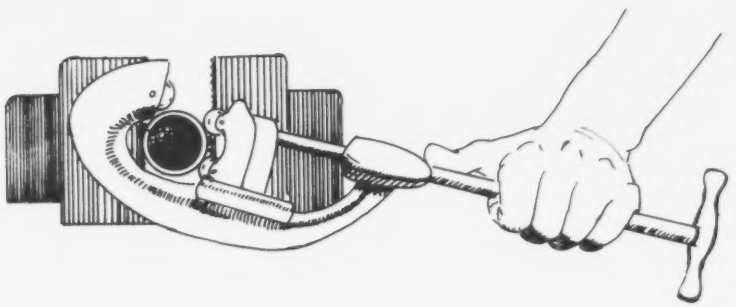
FIGURE 15



JOB SHEET #6

G. Rotate cutter counterclockwise to start groove (Figure 16)

FIGURE 16



H. Tighten cutter 1/4 turn for each full revolution around the pipe

(NOTE: Overtightening can cause cutters to break.)

I. Continue process until pipe is cut through

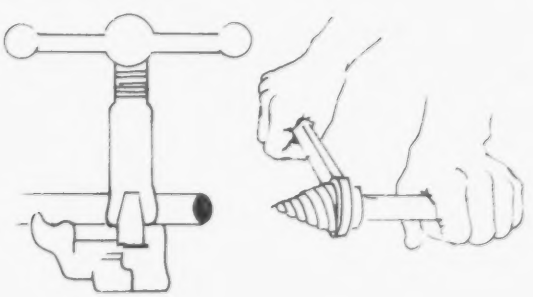
CAUTION

When cutting short pieces of pipe, be careful not to cut your arm while rotating the cutter around the pipe.

J. Clean pipe and cutter with shop towel

K. Insert reamer tip in pipe (Figure 17)

FIGURE 17



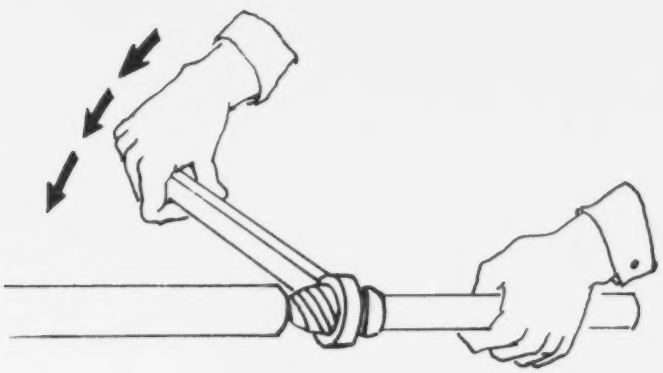
L. Apply light forward pressure to push reamer into pipe

JOB SHEET #6

M. Start rotating reamer (Figure 18)

(NOTE: Reamer should bite instantly if proper pressure is applied. Reamer can be damaged if rotated in the wrong direction.)

FIGURE 18

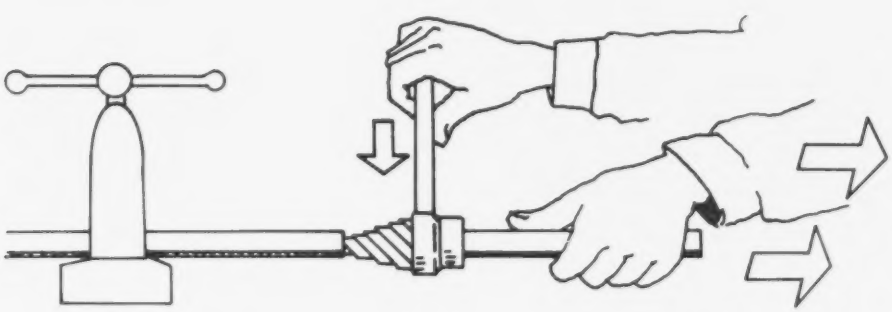


N. Rotate reamer until burrs are removed (See Figure 18)

O. Pull reamer back while continuing to rotate (Figure 19)

(NOTE: This prevents the reamer from leaving a burr.)

FIGURE 19



P. Clean reamer with shop towel

Q. Place drip pan under vise and end of pipe

(NOTE: Metal drip pan is used to catch dripping oil and steel cuttings.)

R. Lubricate end of pipe with cutting oil

JOB SHEET #6

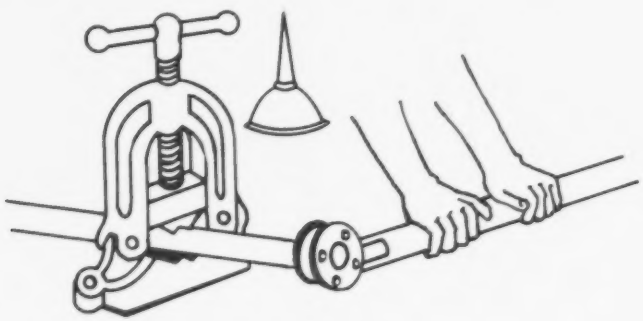
S. Secure and position ratchet die in die stock

T. Place die on pipe

U. Start die straight on the pipe

V. Press die on pipe evenly and turn the die (Figure 20)

FIGURE 20



W. Apply plenty of cutting oil while turning the die

X. Continue turning pipe die and cutting until the desired amount of threads have been cut

Y. Reverse ratchet by turning lock 180° and remove die by turning counterclockwise

(NOTE: Hold onto the die stock firmly while removing it so as not to drop it when it comes to the end of the threads.)

Z. Clean threads with a brush

CAUTION

Do not use compressed air for cleaning.

AA. Have instructor check your work

BB. Clean up area and put away tools and equipment

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #7 — CUT, REAM, AND JOIN COPPER TUBING USING THE SWEAT METHOD

I. Tools and materials

A. Tubing cutter

B. Reamer

C. Sand cloth

D. Flux with small brush

E. Torch and accessories

F. Gas tank with wrench

G. Striker

H. Wire solder

I. Wiping cloth

J. Tubing

K. Fitting

L. Colored safety glasses

II. Procedure

A. Put on colored safety glasses

B. Cut tubing to desired length

C. Ream end of cut tubing

D. Clean tubing end with sand cloth

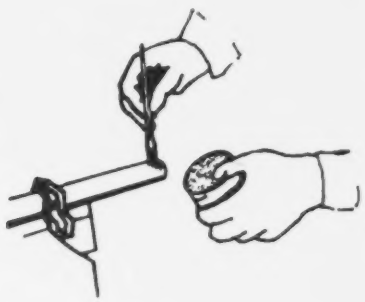
E. Clean fitting socket with sand cloth

JOB SHEET #7

F. Apply thin coat of flux to tubing end and fitting socket (Figure 21)

(NOTE: A small brush used to apply the flux helps to keep out dirt.)

FIGURE 21



G. Insert tubing end into fitting socket

(NOTE: Twist the tubing while inserting in order to spread the flux evenly.)

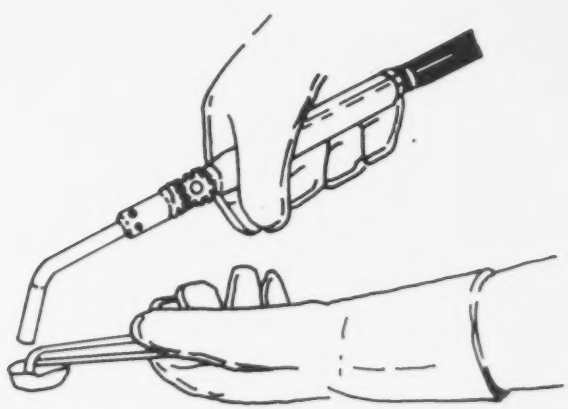
H. Clean away excess flux with cloth

I. Carefully secure tubing and fitting in vise

J. Light and adjust torch (Figure 22)

(NOTE: Always use a striker to light torch.)

FIGURE 22



JOB SHEET #7

K. Apply heat to fitting (Figure 23)

(NOTE: The inner blue cone of the flame should be about 1/8-inch away from the fitting.)

FIGURE 23

L. Move the torch flame around the entire joint

M. Apply solder (Figure 24)

(NOTE: Amount of solder is determined by size of tubing, for example, 1/2-inch tubing will need approximately 1/2-inch wire solder, and 3/4-inch tubing needs 3/4-inch wire solder.)

FIGURE 24

N. Discontinue heat and solder application when solder flows from joint

O. If necessary, wipe excess solder off with cloth (Figure 25)

FIGURE 25

P. Turn off torch

Q. Allow solder to cool

(NOTE: *Do not* apply water to cool the fitting.)

JOB SHEET #7

R. Have instructor check your work

S. Clean up area and put tools away

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #8 — BEND COPPER TUBING WITH A SPRING BENDER

I. Tools and equipment

A. Approximately two feet of 1/2" diameter copper tubing

B. 1/2" spring bender

II. Procedure

A. Slide tubing bender over tubing to proper location for bend

B. Firmly grip one end of the bending spring with one hand and pull the opposite end toward your body at the approximate angle desired

(NOTE: Both thumbs must nearly touch each other.)

C. Check angle for accuracy to the specific required angle

D. Repeat step B if adjustments need to be made

(NOTE: The bending spring is not a precision tool; experience and judgment are needed to acquire accuracy.)

E. Have instructor check your work

F. Clean up area and put away tools and equipment

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #9 — CUT, REAM, FLARE, AND JOIN COPPER TUBING USING THE FLARE METHOD

I. Tools and materials

A. Tubing cutter

B. Reamer

C. Flaring tool and block

D. Tubing

E. Fittings

F. Adjustable wrench

G. Open-end or flare-nut wrench

H. Hammer-type flaring tool

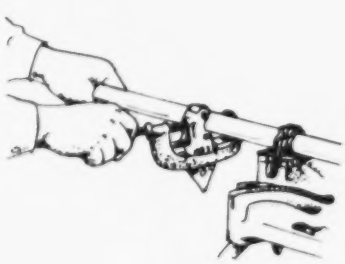
I. Small ball peen hammer

II. Procedure for flaring tool and block

A. Measure and cut a desired length of tubing

1. Place cutter on tubing; do not overtighten (Figure 26)

FIGURE 26



2. Turn a few revolutions and then tighten a little more

3. Continue to tighten a little at a time while turning cutter until tubing is cut

(NOTE: Cutter should not be so tight that it bends the end of the tubing.)

JOB SHEET #9

B. Slip flare nut over end of tubing

C. Ream the end of the tubing

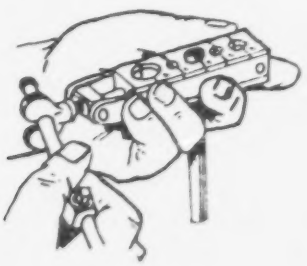
1. Do not over-ream; just remove the burr

2. Point end of tubing slightly downward while reaming to allow chips to fall out

D. Place tubing in flaring block

E. Extend end of tubing above the block face about 1/3 the depth of the block chamfer (Figure 27)

FIGURE 27



F. Secure tubing in flaring block

G. Place flaring tool on block

(NOTE: Flaring tool must be kept oiled and clean.)

H. Tighten cone into tubing a few turns and then back it out

I. Continue the tightening and loosening process until the flare is made

(NOTE: This process tends to make a smooth, polished flare and will lessen the chances of work-hardening the tubing.)

J. Do not overtighten the flaring tool

(NOTE: This will cause the tubing to wash out and possibly cause the flare to split.)

K. Remove flaring tool from block

L. Remove tubing from flaring block

JOB SHEET #9

M. Check fit of flare to seat of flare nut

N. Secure flare nut tightly to flare fitting

O. Duplicate process on other end of flare fitting

P. Have instructor check your work

III. Procedure using hammer-type flaring tool

A. Measure and cut a desired length of tubing

1. Place cutter on tubing; do not overtighten
2. Turn a few revolutions and then tighten a little more
3. Continue to tighten a little at a time while turning cutter until tubing is cut

(NOTE: Cutter should not be so tight that it bends the end of the tubing.)

B. Slip flare nut over end of tubing

C. Ream the end of the tubing

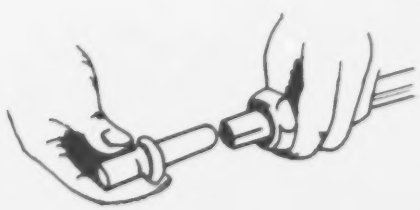
1. Do not over-ream; just remove the burr
2. Point end of tubing slightly downward while reaming to allow chips to fall out

D. Carefully clean inside end of tubing

E. Carefully clean flaring tool

F. Place end of flaring tool in end of tubing (Figure 28)

FIGURE 28

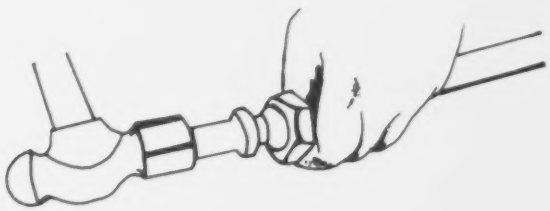


JOB SHEET #9

G. Holding tubing and flaring tool in one hand, drive flaring tool into tubing with hammer (Figure 29)

(NOTE: Tubing and flaring tool must be held straight.)

FIGURE 29



H. Drive flaring tool into tubing until desired flare is formed

(NOTE: This may require checking flare on fitting.)

I. Remove flaring tool from tubing

(NOTE: This may require turning flaring tool in order to loosen it.)

J. Check fit of flare to seat of flare nut

K. Secure flare nut tightly to flare fitting

L. Duplicate process on other end of flare fitting

M. Have instructor check your work

N. Clean up area and put tools away

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #10 — CUT, REAM, AND JOIN COPPER TUBING
USING THE COMPRESSION METHOD

I. Tools and materials

A. Tubing cutter

B. Reamer

C. Fitting

D. Tubing

E. Open-end wrench or flare-nut wrench

F. Adjustable wrench

II. Procedure

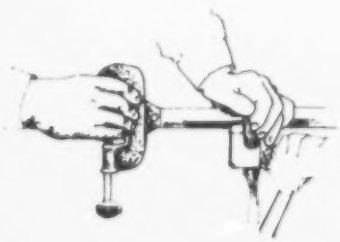
A. Cut tubing to desired length

B. Slip fitting nut and ferrule over end of tubing

C. Ream end of tubing (Figure 30)

(NOTE: If tubing is reamed before installing fitting sleeve, the sleeve might not fit over end of tubing.)

FIGURE 30



D. Insert end of tubing into fitting

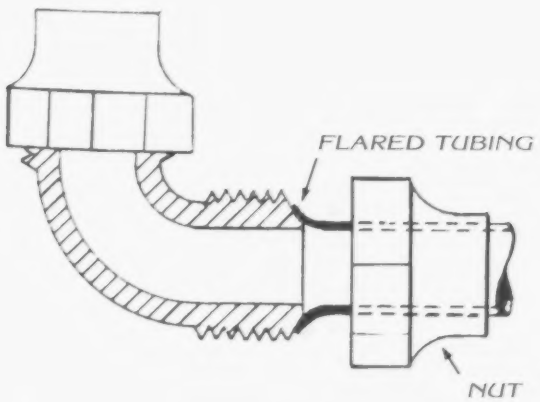
(NOTE: Tubing end must fit snugly against bottom of fitting socket.)

E. Slide fitting nut and ferrule up against threaded end of fitting

JOB SHEET #10

F. Make nut hand-tight on fitting (Figure 31)

FIGURE 31



G. Hold body of fitting with adjustable wrench

H. Turn fitting nut with flare-nut wrench or open-end wrench

(NOTE: Keep tubing tight against bottom of fitting socket while tightening nut.)

I. Complete tightening of nut on fitting

J. Duplicate process on other end of fitting

L. Have instructor check your work

M. Clean up area and put tools away

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #11 — CUT, REAM, AND JOIN PLASTIC PIPE

I. Tools and materials

A. Pipe cutter or handsaw with mitre box

B. Reamer or knife

C. Cleaning solvent with brush or abrasive paper

D. Solvent cement with brush

E. PVC pipe

F. PVC fittings

G. Wiping cloth

H. Flexible plastic pipe

I. Plastic insert fittings

J. Clamps

K. Screwdriver

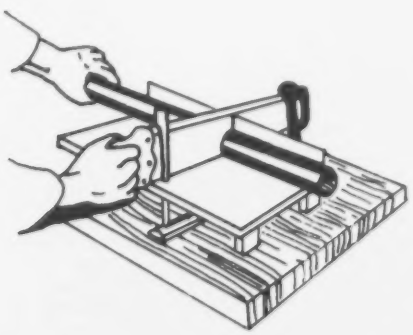
L. Socket wrench

II. Procedure for PVC pipe

A. Measure and cut pipe to desired length

(NOTE: A mitre box and mitre saw ensure å square cut. See Figure 32.)

FIGURE 32



JOB SHEET #11

B. Ream pipe

CAUTION

Since most PVC reaming is done with a pocket knife or other type of knife, care must be used in this operation.

C. Apply solvent cleaner to pipe end of fitting socket

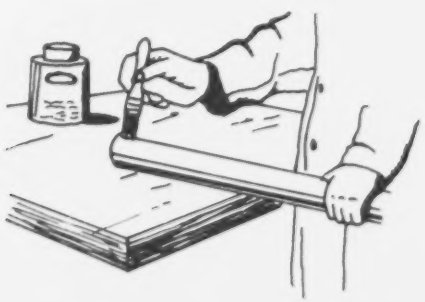
(NOTE: Abrasive paper such as sand cloth or emery cloth may be used.)

D. Wipe solvent cleaner from the pipe end and fitting socket

(NOTE: This cleans the pipe and removes the gloss for better bonding.)

E. Apply a light, even coat of solvent cement to the pipe end and fitting socket (Figure 33)

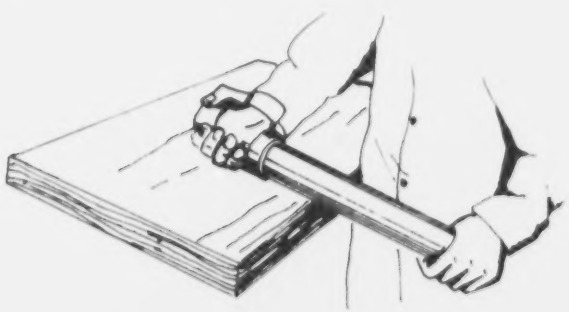
FIGURE 33



F. Insert pipe all the way into the fitting socket while giving it a quarter turn (Figure 34)

(NOTE: This operation must be done quickly as the cement sets up in a few seconds.)

FIGURE 34



JOB SHEET #11

G. Allow 24 hours before testing PVC joint

H. Have instructor check your work

III. Procedure for flexible plastic pipe

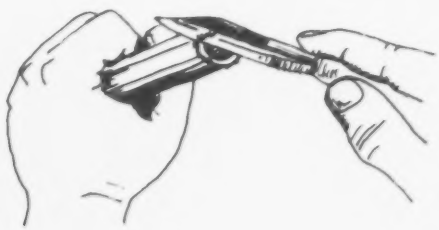
A. Measure and cut pipe to desired length

B. Ream pipe (Figure 35)

CAUTION

Since most flexible plastic pipe is cut and reamed with a knife, care must be used in this operation.

FIGURE 35



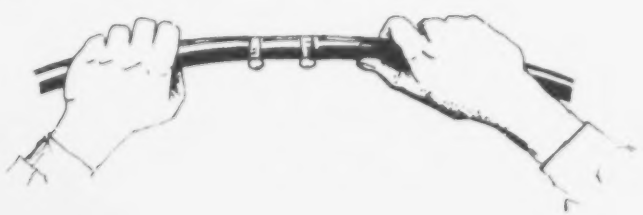
C. Slip clamp over end of pipe

(NOTE: Open clamp enough for it to fit loosely on the pipe.)

D. Holding pipe in one hand and the fitting in the other, force fitting into end of pipe (Figure 36)

(NOTE: Cold [rigid] or heavy gauge pipe may need to be softened by hot water or a small flame from a torch.)

FIGURE 36

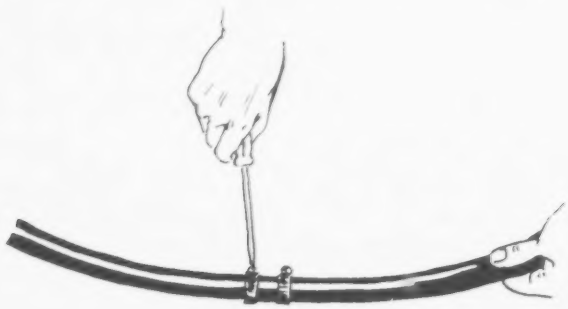


JOB SHEET #11

E. Slip clamp over inserted fitting and tighten with screwdriver (Figure 37)

(NOTE: Some clamps are fitted with hex nuts to accommodate socket wrenches.)

FIGURE 37



F. Complete same process on other end of fitting

G. Have instructor check your work

H. Clean up area and put tools away

PLUMBING BASIC SKILLS
UNIT IV

JOB SHEET #12 — JOIN CAST IRON PIPE TO A CAST IRON FITTING USING A NO-HUB JOINT

I. Tools and materials

A. Neoprene gasket

B. Stainless steel shield and clamp assembly

C. Torque socket wrench

D. No-hub cast iron pipe

E. No-hub cast iron fitting

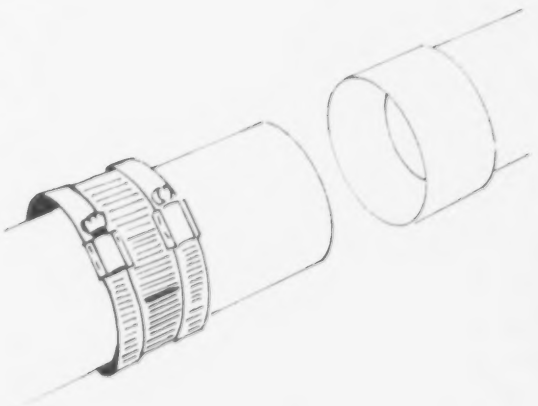
II. Procedure

A. Place neoprene gasket over one end of fitting

(NOTE: In this method of joining, no hubs are used.)

B. Place the stainless steel shield and clamp assembly over the end of the pipe (Figure 38)

FIGURE 38



C. Fit ends of the pipe and fitting against the molded shoulders inside the gasket

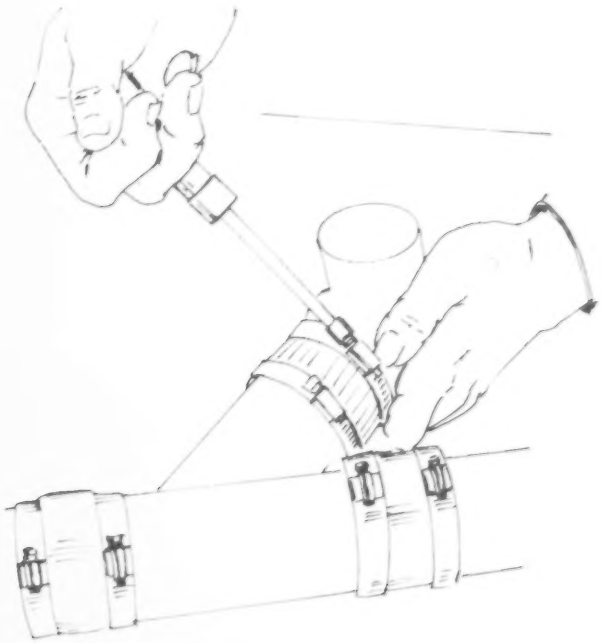
(NOTE: Pipe and fitting ends must fit snugly.)

JOB SHEET #12

D. Slide shield and clamp assembly over gasket and tighten clamps (Figure 39)

(NOTE: A special torque socket wrench is available for tightening clamps.)

FIGURE 39



E. Have instructor check your work

F. Clean up area and put tools away

PLUMBING BASIC SKILLS
UNIT IV

TEST

NAME _____ SCORE _____

1. Match terms associated with plumbing basic skills to their correct definitions. Write the correct numbers in the blanks.

_____a. Method of using a solvent to join PVC pipe

_____b. Method of joining copper tubing using flux and solder applied with heat

_____c. Removing burrs from inside edge of pipe

_____d. Type of cast iron pipe to be joined by special fittings

_____e. Cutting spiral grooves on the end of pipe to facilitate joining with a fitting

_____f. Substance applied to pipe threads to help seal the joint

_____g. Expanded end of cast iron pipe which receives the end of pipe or fitting

_____h. Method of joining flexible plastic pipe

_____i. End of fitting or pipe which is inserted into hub

_____j. Insert in cast iron hub which makes up part of a watertight compression joint

_____k. Tape used as a joint sealant in place of pipe compound

1. Threading
2. Cementing
3. Insert joining
4. Reaming
5. No-hub
6. Neoprene gasket
7. Hub
8. Spigot end
9. Pipe compound (dope)
10. Sweating
11. Teflon tape

2. State eight basic skills necessary to perform plumbing jobs.

a. _____

b. _____

c. _____

d. _____

TEST

e. _____

f. _____

g. _____

h. _____

3. Select from the following list tools, materials, and equipment necessary to join steel pipe. Write an "X" in the blank before each correct answer.

_____a. Metal cutters

_____b. Cutting oil

_____c. Bench vise

_____d. Pipe fitting

_____e. Reamer

_____f. Solvent cement

_____g. Pipe wrench

_____h. Teflon tape

_____i. Neoprene gasket

_____j. Clamps

_____k. Pipe dies, head, and stock

_____l. Steel pipe

4. Select from the following list tools, materials, and equipment necessary to join copper tubing. Write an "X" in the blank before each correct answer.

a. Sweat joint method

_____1) Wiping cloth

_____2) Type B gas tank with wrench

_____3) Steel pipe

_____4) Fire extinguisher

_____5) Swaging tool

TEST

_____6) Emery cloth

_____7) Teflon tape

_____8) Tubing cutter with reamer

_____9) Compression fitting

_____10) Torch handle and accessories

_____11) Sweat fitting

_____12) Wire solder

b. Compression method

_____1) Flare-nut wrench

_____2) Ferrule and nut

_____3) Socket wrench

_____4) Tubing cutter with reamer

_____5) Wiping cloth

_____6) Copper tubing

c. Flare method

_____1) Swaging tool

_____2) Flaring tool and block

_____3) Adjustable pipe dies

_____4) Screwdriver

_____5) Open-end or flare-nut wrench

_____6) Flare fitting

_____7) Tubing cutter with reamer

_____8) Small ball peen hammer

_____9) Hammer-type flaring tool

_____10) Copper tubing

TEST

5. Select from the following list tools, materials, and equipment necessary to join plastic pipe. Write an "X" in the blank before each correct answer.

   a. PVC pipe

      _____1) Solvent cement and brush

      _____2) Clamps

      _____3) PVC pipe

      _____4) Reamer

      _____5) Handsaw with mitre box

      _____6) Wiping cloth

      _____7) Fitting

      _____8) Sandpaper or emery cloth

   b. Flexible plastic pipe

      _____1) Wiping cloth

      _____2) Approved torque socket wrench

      _____3) Reamer or knife

      _____4) Fitting

      _____5) Pipe compound

      _____6) Flexible plastic pipe

      _____7) Screwdriver

      _____8) Cleaning solvent with brush

      _____9) Pipe cutter or handsaw

      _____10) Clamps

6. Select from the following list tools, materials, and equipment necessary to join no-hub type cast iron pipe.

   _____a. Neoprene gasket

   _____b. Cast iron pipe

TEST

_____c. Cleaning solvent with brush

_____d. Stainless steel shield and clamp assemblies

_____e. Screwdriver

_____f. Fitting

(NOTE: Test item seven lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Demonstrate the ability to

   a. Measure and mark a predetermined length of pipe.

   b. Use a pipe cutter to cut a length of steel pipe.

   c. Use a hacksaw to cut a length of steel pipe.

   d. Use a pipe reamer to remove burrs from steel pipe.

   e. Cut threads on a piece of steel pipe.

   f. Cut, ream, thread, and join a piece of one-inch galvanized steel pipe.

   g. Cut, ream, and join copper tubing using the sweat method.

   h. Bend copper tubing with a spring bender.

   i. Cut, ream, flare, and join copper tubing using the flare method.

   j. Cut, ream, and join copper tubing using the compression method.

   k. Cut, ream, and join plastic pipe.

   l. Join cast iron pipe to cast iron fitting using a no-hub joint.

PLUMBING BASIC SKILLS
UNIT IV

ANSWERS TO TEST

1.

a. 2	e. 1	i. 8
b. 10	f. 9	j. 6
c. 4	g. 7	k. 11
d. 5	h. 3	

2. Answer should include any eight of the following.

   a. Measure and mark pipe accurately
   b. Use a pipe cutter and a hacksaw to cut off steel pipe
   c. Use a pipe reamer to remove burrs on steel pipe
   d. Use a pipe die to cut threads on steel pipe
   e. Use a tubing cutter to cut off copper tubing
   f. Use a reamer to remove burrs on copper tubing
   g. Use a flaring tool and block to flare end of copper tubing
   h. Use a hammer-type flaring tool and swaging tool to flare end of copper tubing
   i. Use a torch and accessories to sweat joints on copper tubing
   j. Join copper tubing using the compression method
   k. Use a pipe cutter and a handsaw to cut plastic pipe
   l. Use a reamer and a knife to remove burrs from plastic pipe
   m. Join PVC plastic pipe
   n. Join flexible plastic pipe
   o. Join no-hub cast iron pipe
   p. Join hub-type cast iron pipe

3. b, d, e, g, h, k, l

4. a. 1, 2, 4, 6, 8, 10, 11, 12
   b. 1, 2, 4, 6
   c. 1, 2, 5, 6, 7, 8, 9, 10

5. a. 1, 3, 4, 5, 6, 7
   b. 3, 4, 6, 7, 9, 10

6. a, b, d, f

7. Performance skills evaluated to the satisfaction of the instructor.